United States
Department of
Agriculture

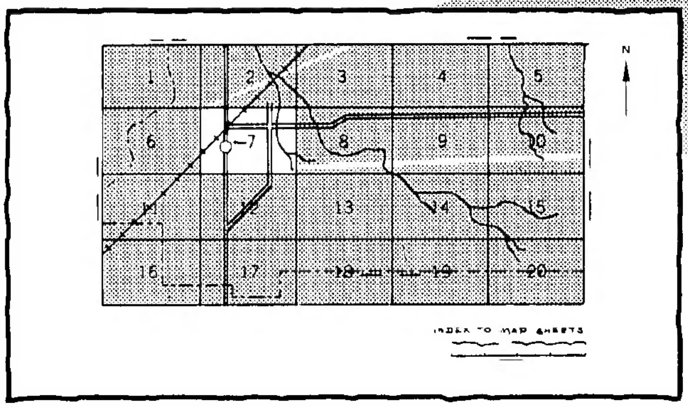
Soil
Conservation
Service

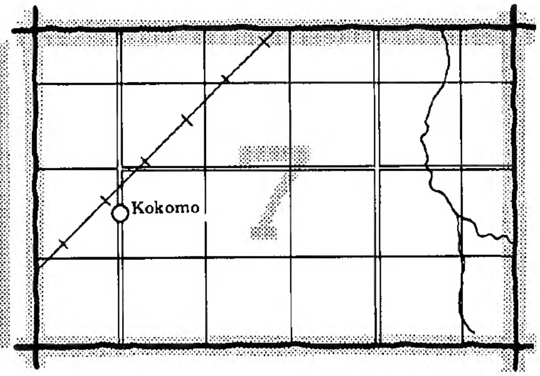
In cooperation with
Kansas Agricultural
Experiment Station

Soil Survey of Decatur County, Kansas

HOW TO USE

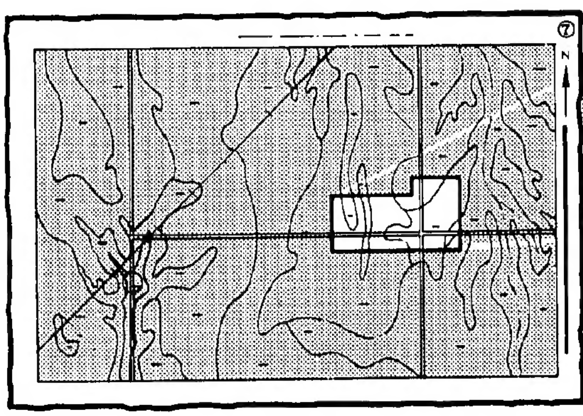
1. Locate your area of interest on the "Index to Map Sheets."

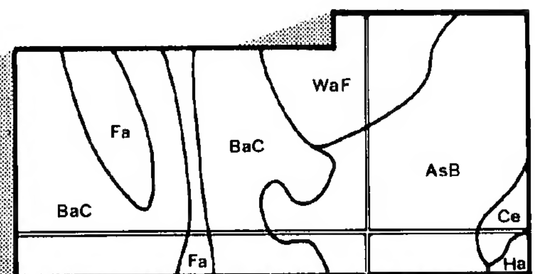




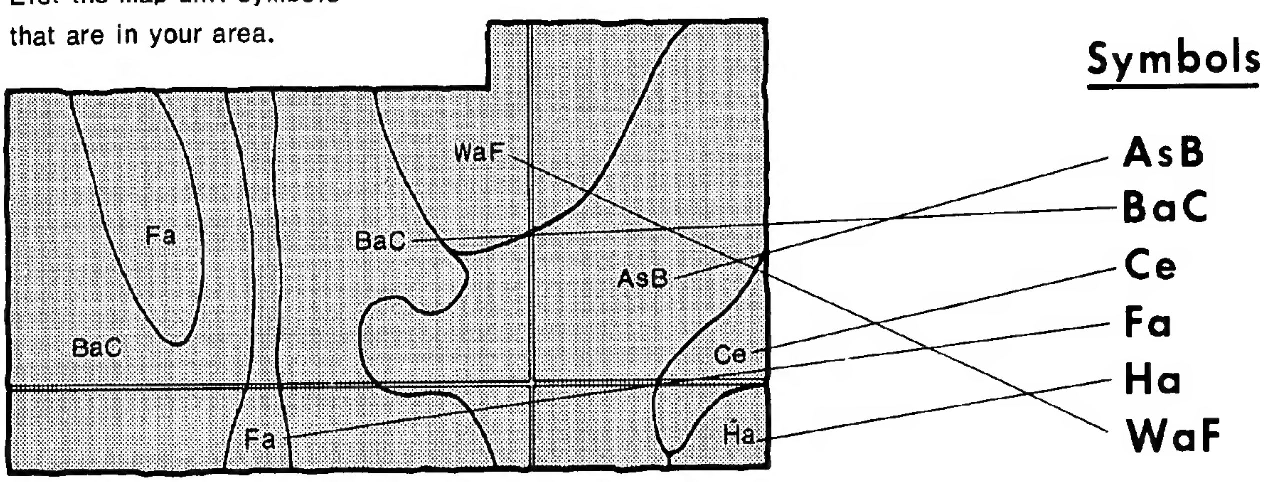
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



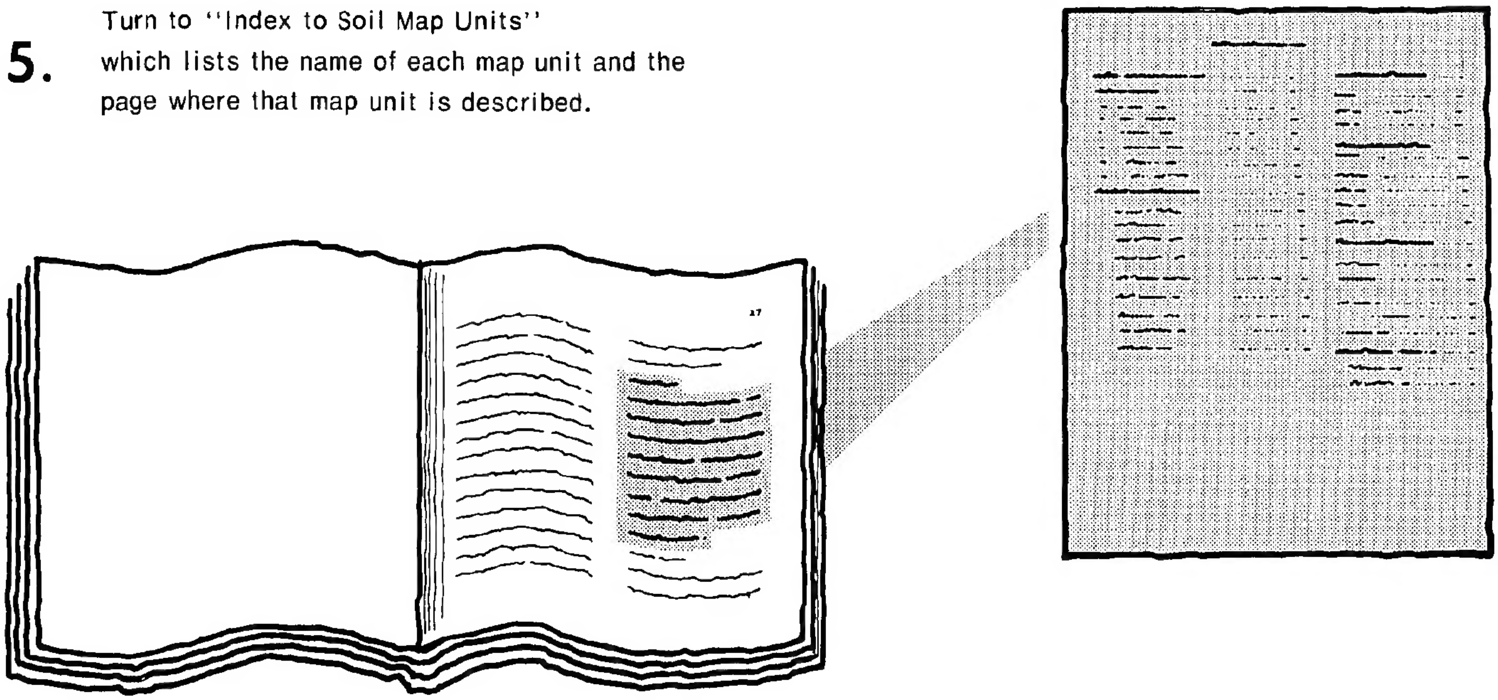


4. List the map unit symbols that are in your area.

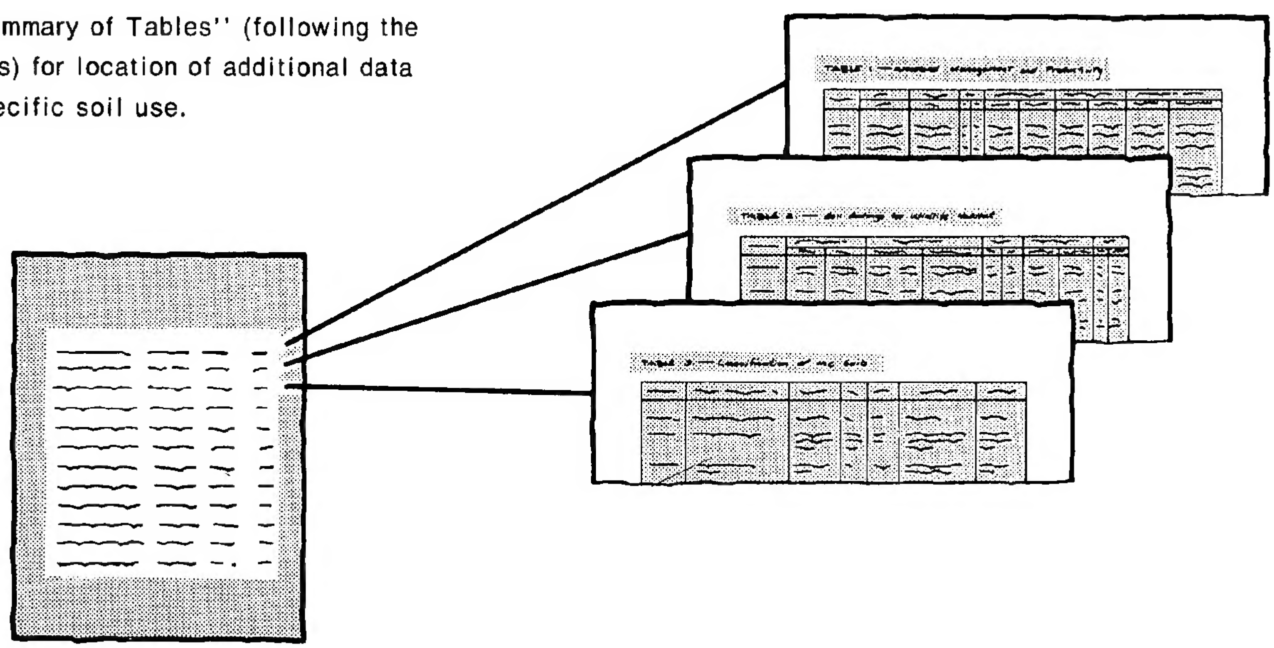


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was performed in the period 1981 to 1984. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Decatur County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Trees along a channel in an area of Bridgeport soils. Rock outcrops and Penden and Canlon soils are in the foreground, and Uly soils are in the background.

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Soil Series

Issued April 1989

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Decatur County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie

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State Conservationist
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Soil Survey of Decatur County, Kansas

By Vernon L. Hamilton, Raymond C. Angell, and Bobby D. Tricks,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Kansas Agricultural Experiment Station

General Nature of the County

DECATUR COUNTY is in the northwestern part of Kansas (fig. 1). It has an area of 572,126 acres, or about 894 square miles. In 1983, it had a population of 4,767. Oberlin, the county seat, had a population of 2,538.

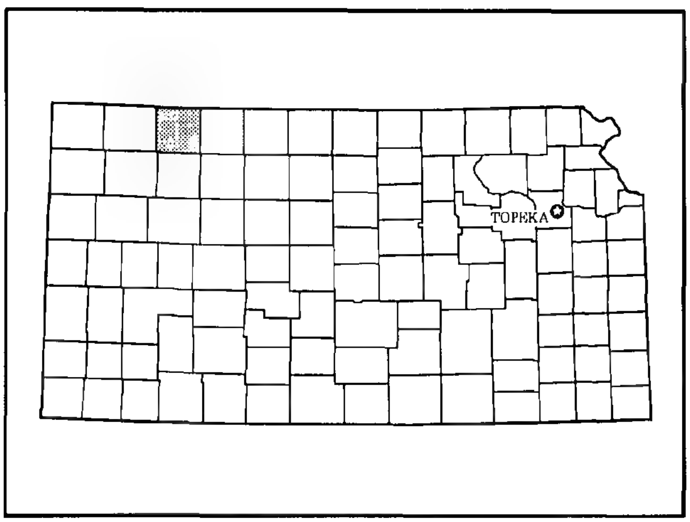

Figure 1.—Location of Decatur County in Kansas.

The southwestern part of the county is in the Central High Tablelands major land resource area, and the northern and eastern parts are in the Rolling Plains and Breaks major land resource area. The soils in the county generally are deep, are nearly level to strongly sloping, and have a silty subsoil. Elevation ranges from about 2,330 to 2,970 feet above sea level. Most of the county is drained by Beaver Creek, Sappa Creek, Prairie Dog Creek, and the North Fork of the Solomon River (fig. 2). These streams are intermittent and flow in a northeasterly direction across the county.

Farming and ranching are the main enterprises in the county. About 61 percent of the county is cropland, 37 percent is rangeland, and 2 percent is woodland, farmsteads, roads, or urban and other areas (*3*). Winter wheat, grain sorghum, corn, and alfalfa are the principal crops. Most of the acreage used for corn is irrigated.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate in Decatur County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. The climate is characterized by large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air. The cold temperatures prevail from December to February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops in the county. Spring and fall are relatively short.

Decatur County generally is to the west of the flow of moisture-laden air from the Gulf of Mexico and to the east of the strong rain-shadow effects of the Rocky Mountains. The net result is an annual amount of precipitation that is marginal for cropping year after year. Precipitation is in the form of showers and thunderstorms that can be extremely heavy at times. Winds are relatively high and can cause significant soil loss and

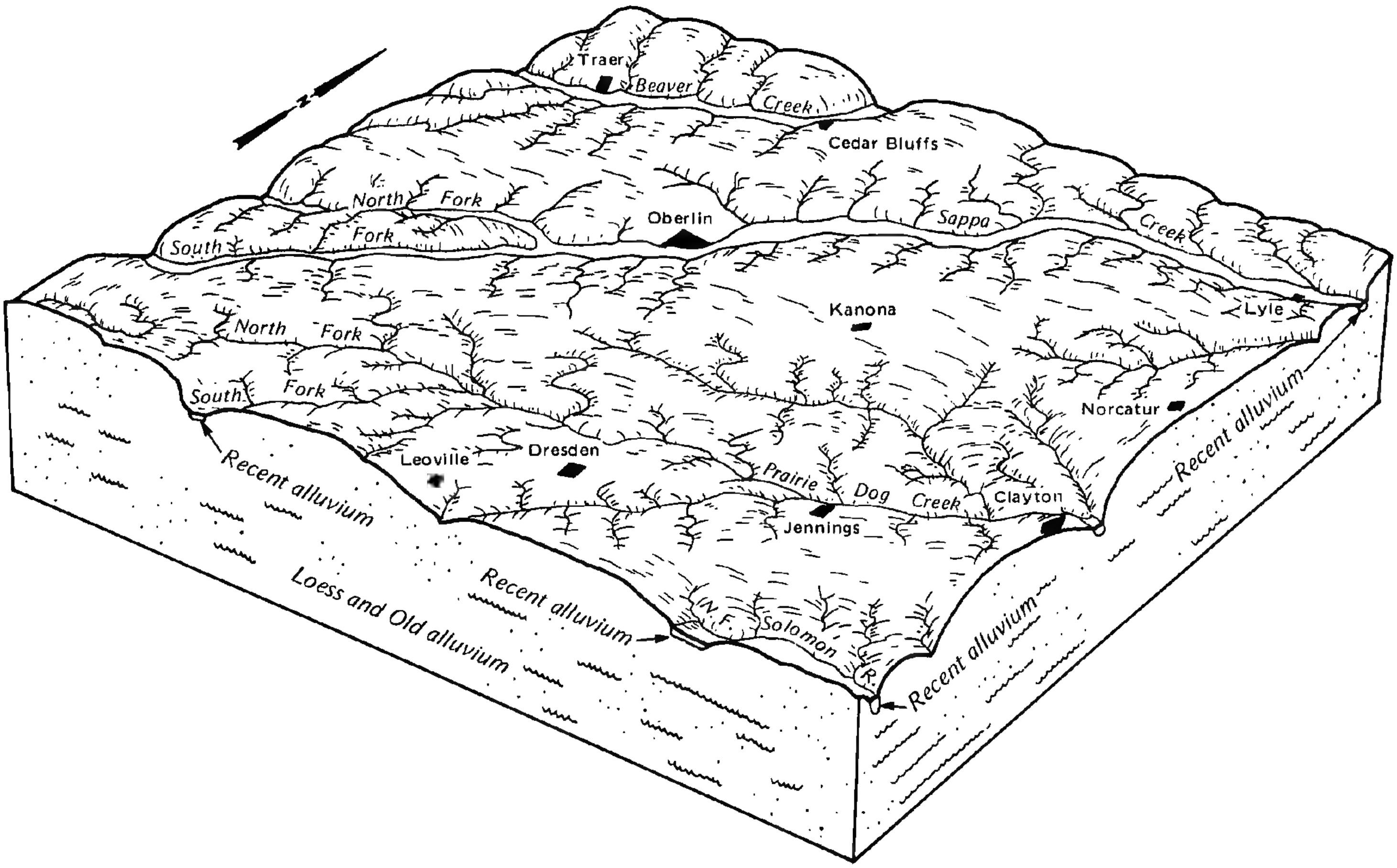

Figure 2.—Drainage pattern, relief, and geology in Decatur County.

crop damage in the drier years. Conservation practices are necessary to conserve moisture and prevent excessive soil loss.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Oberlin in the period 1941 to 1970. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 30.7 degrees F, and the average daily minimum temperature is 16.7 degrees. The lowest temperature on record, which occurred at Oberlin on January 11, 1918, is -32 degrees. In summer the average temperature is 75.5 degrees, and the average daily maximum temperature is 90.2 degrees. The highest recorded temperature, which occurred at Dresden on July 24, 1983, is 118 degrees.

The total annual precipitation is 20.69 inches. Of this, 16.51 inches, or nearly 80 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 13.22 inches. The heaviest recorded 1-day rainfall, which occurred at Oberlin on July 27, 1893, is 5.57 inches.

The average seasonal snowfall is 31 inches. The highest recorded seasonal snowfall, which occurred during the winter of 1973-74, is 66.8 inches. On the average, 38 days of the year have at least 1 inch of snow on the ground. The snow cover rarely lasts more than 2 weeks in succession.

The sun shines 77 percent of the time possible in summer and 67 percent in winter. The prevailing wind is from the south. Average windspeed is 10.7 miles per hour. It is highest, 13 miles per hour, in March.

Severe thunderstorms and tornadoes strike occasionally. These storms are usually local in extent and of short duration, so that the risk of damage is small. Hail falls during warm periods. The hailstorms are infrequent, however, and are of local extent. They cause less crop damage in this county than in counties farther west.

Natural Resources

Soil is the most important natural resource in the county. It provides a growing medium for range plants and field crops. If managed and used properly, the soil is a renewable resource.

Water is available in sufficient quantity and quality for irrigation in many areas of the county. It is pumped from the Ogallala Formation and from wells in alluvial and terrace deposits along the major streams. Recharge of water in the Ogallala aquifer is minor, and the water level is declining in areas where use is heavy. Recharge in the alluvial and terrace deposits is somewhat higher, but heavy pumping has reduced streamflow during periods of heavy use.

Other natural resources include sand, gravel, oil, and volcanic ash. An adequate supply of sand and gravel is available for roads and other uses. The ash is quarried for use as a mineral filler in road construction.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Map Unit Descriptions

This section describes the map units in the survey area at two levels of detail. The general soil map units, called soil associations, are described first and then the detailed map units. Most of the general soil map units represent the soils of major extent in the survey area. The detailed map units represent all of the named soils in the survey area.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications of series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

1. Holdrege-Uly Association

Deep, nearly level to moderately sloping, well drained soils that have a silty subsoil; on uplands

This association is on broad ridgetops and side slopes that are dissected by small drainageways. Slope ranges from 0 to 7 percent.

This association makes up about 65 percent of the county. It is about 70 percent Holdrege soils, 20 percent Uly soils, and 10 percent minor soils (fig. 3).

The nearly level and gently sloping Holdrege soils formed in loess, mainly on the divides between drainageways. Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam about 14 inches thick. The upper part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown, and the lower part is very pale brown.

The moderately sloping Uly soils formed in loess on the upper side slopes along drainageways and on low ridges. Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The minor soils in this association are the Coly, McCook, and Pleasant soils. The calcareous Coly soils are on the steeper side slopes. The occasionally flooded McCook soils are on flood plains. The moderately well drained Pleasant soils are in upland depressions.

This association is used mainly for cultivated crops. Wheat and grain sorghum are the main dryland crops. Corn, grain sorghum, wheat, and alfalfa are the main irrigated crops. Controlling water erosion, conserving moisture, and maintaining tilth and fertility are the main concerns in managing the cultivated areas.

2. Coly-Uly-Holdrege Association

Deep, gently sloping to moderately steep, well drained soils that have a silty subsoil; on uplands

This association is on ridgetops and side slopes that are dissected by entrenched drainageways. Slope ranges from 1 to 20 percent.

This association makes up about 10 percent of the county. It is about 40 percent Coly soils, 30 percent Uly soils, 20 percent Holdrege soils, and 10 percent minor soils (fig. 4).

The moderately steep Coly soils formed in loess on the lower side slopes. Typically, the surface layer is light brownish gray, calcareous silt loam about 5 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 4 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

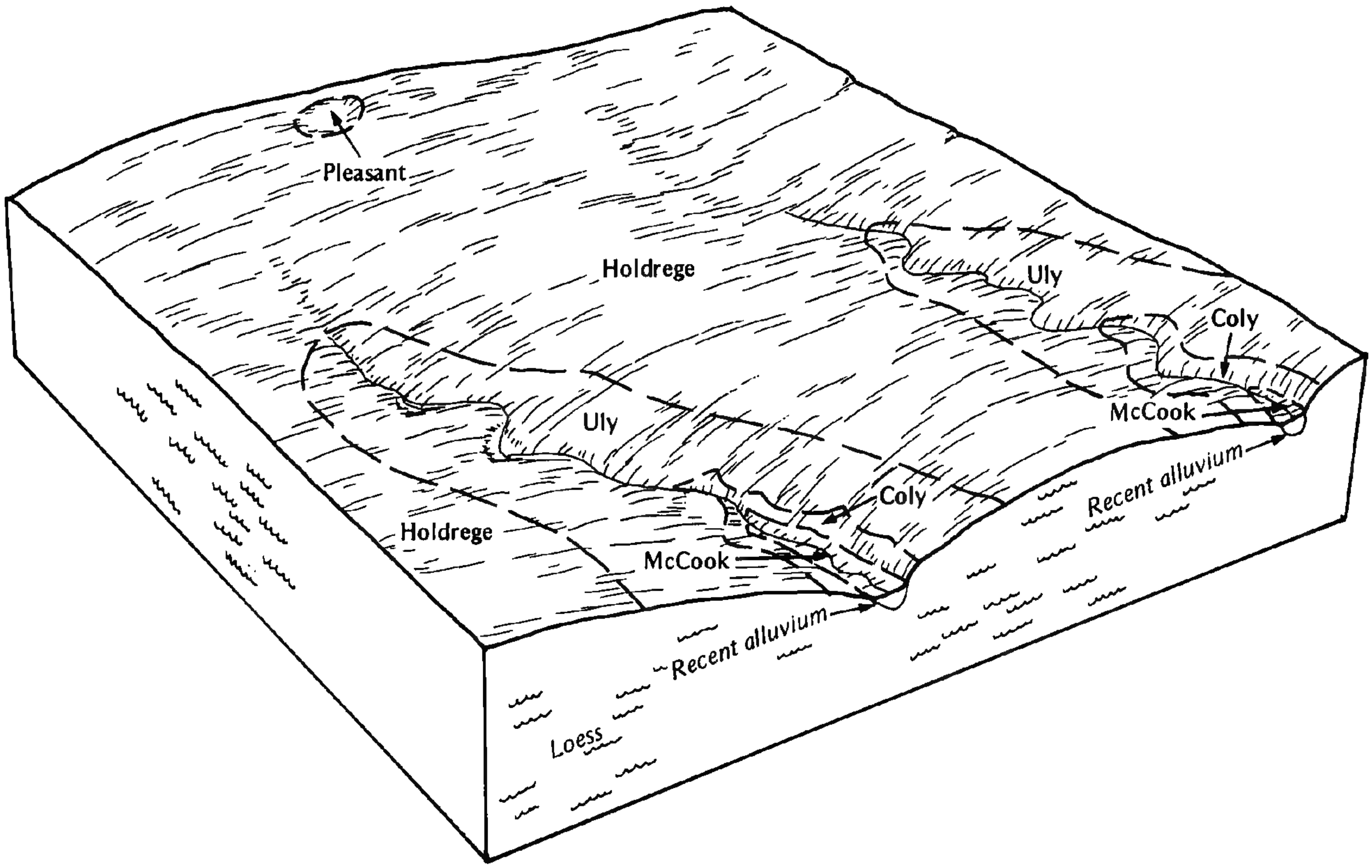

Figure 3.—Typical pattern of soils and parent material in the Holdrege-Uly association.

The moderately sloping and strongly sloping Uly soils formed in loess, mainly on the upper side slopes along drainageways. Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The gently sloping Holdrege soils formed in loess, mainly on the divides between drainageways. Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam about 14 inches thick. The upper part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown, and the lower part is very pale brown.

The minor soils in this association are the Canlon, McCook, and Penden soils. The shallow Canlon soils and the loamy Penden soils are on the sides of deeply entrenched drainageways. The occasionally flooded McCook soils are on flood plains.

Most of the less sloping areas of this association are cultivated. The steeper areas are used mainly as range. Wheat and grain sorghum are the main dryland crops. A few areas are irrigated. Corn, grain sorghum, alfalfa, and wheat are the main irrigated crops. Controlling water erosion, maintaining tilth and fertility, and conserving moisture are the main concerns in managing the cultivated areas. Maintaining the growth and vigor of the desirable grasses is the main concern in managing range.

3. Uly-Coly-Penden Association

Deep, moderately sloping to moderately steep, well drained soils that have a silty or loamy subsoil; on uplands

This association is on narrow ridgetops and side slopes that are dissected by drainageways. Slope ranges from 3 to 20 percent.

This association makes up about 18 percent of the county. It is about 40 percent Uly soils, 30 percent Coly soils, 13 percent Penden soils, and 17 percent minor soils (fig. 5).

The moderately sloping and strongly sloping Uly soils formed in loess on the upper side slopes. Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The moderately steep Coly soils formed in loess on side slopes that generally are below the Uly soils and above the Penden soils. Typically, the surface layer is light brownish gray, calcareous silt loam about 5 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 4 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The strongly sloping and moderately steep Penden soils formed in loamy old alluvium on the lower side slopes. Typically, the surface layer is grayish brown, calcareous loam about 8 inches thick. The subsurface layer is brown, calcareous clay loam about 8 inches thick. The subsoil is very pale brown, friable, calcareous clay loam about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam.

The minor soils in this association are the Canlon, Holdrege, and McCook soils. The shallow Canlon soils are on the steeper side slopes. The gently sloping Holdrege soils are on ridgetops. They have a silty subsoil. The occasionally flooded McCook soils are on flood plains.

This association is used mainly as range. Some of the less sloping areas are used for cultivated crops, mainly wheat and grain sorghum. Controlling water erosion, conserving moisture, and maintaining tilth and fertility are the main concerns in managing the cultivated areas. Maintaining the growth and vigor of the desirable grasses is the main concern in managing range.

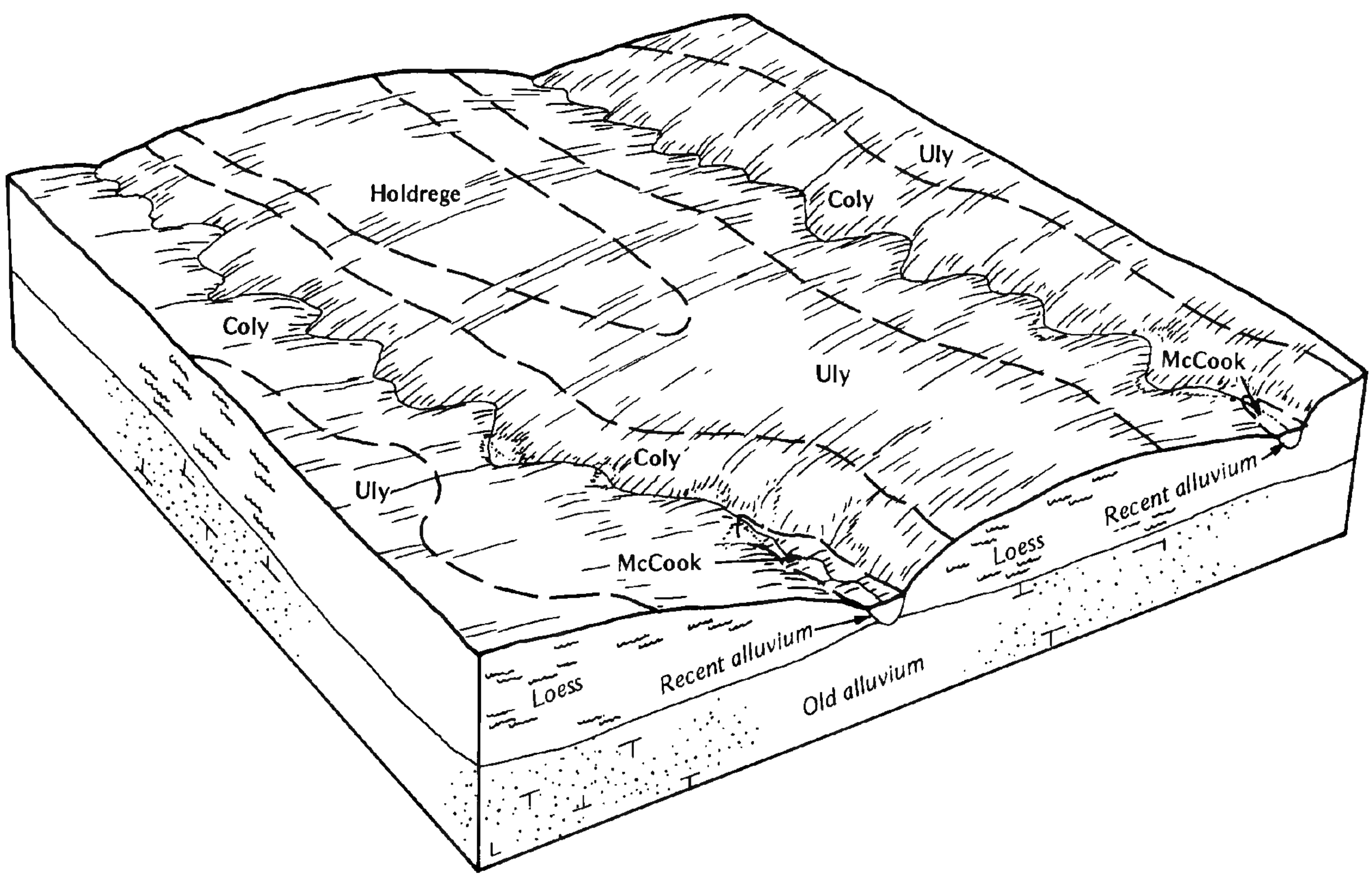

Figure 4.—Typical pattern of soils and parent material in the Coly-Uly-Holdrege association.

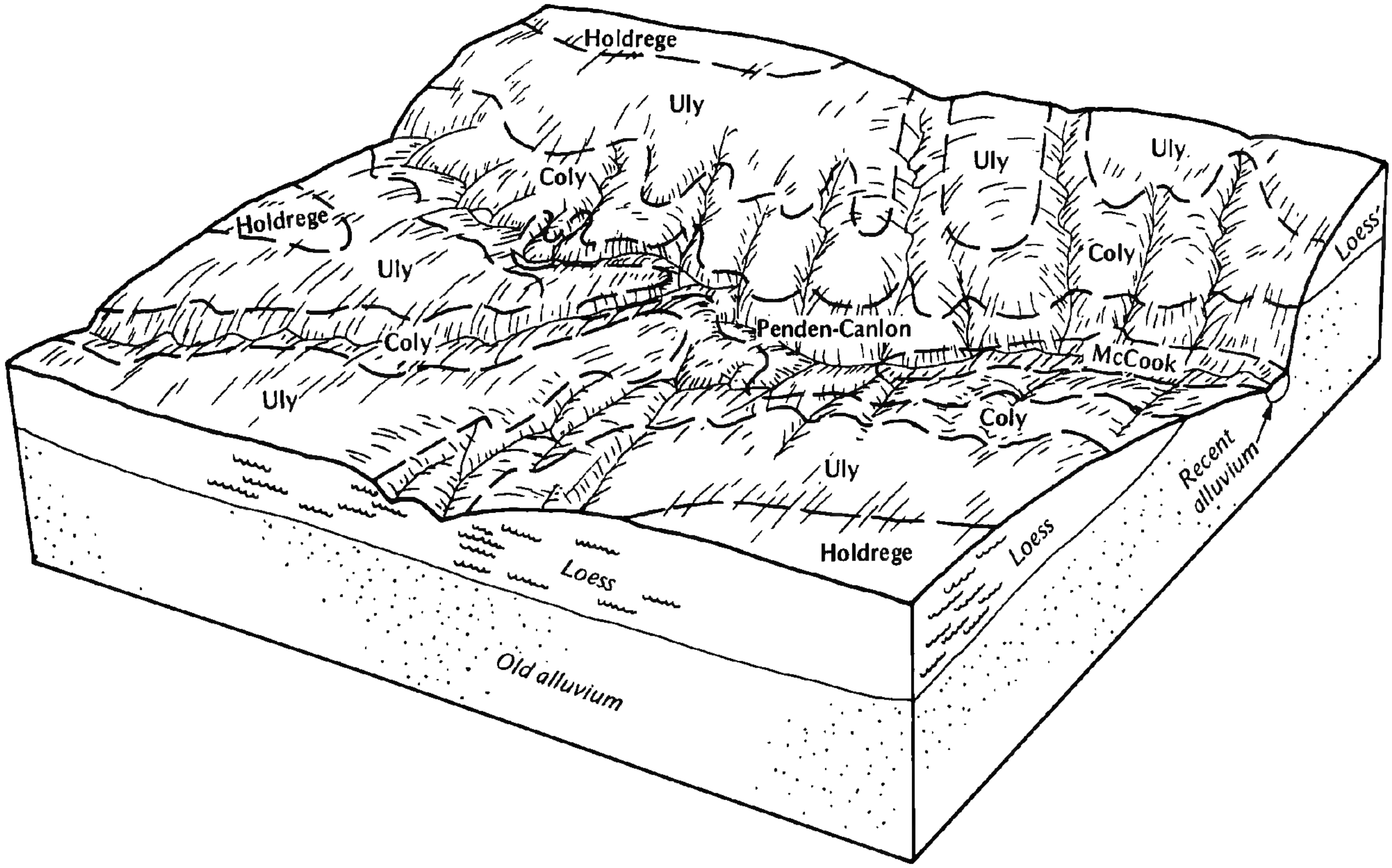

Figure 5.—Typical pattern of soils and parent material in the Uly-Coly-Penden association.

4. Bridgeport-McCook Association

Deep, nearly level and gently sloping, well drained soils that have a silty subsoil; on stream terraces, flood plains, and alluvial fans

This association is on bottom land along the major streams. Slope is mainly less than 2 percent but ranges from 0 to 5 percent.

This association makes up about 7 percent of the county. It is about 60 percent Bridgeport soils, 30 percent McCook soils, and 10 percent minor soils.

The nearly level and gently sloping Bridgeport soils formed in calcareous, silty alluvium. Typically, the surface layer is grayish brown, calcareous silt loam about 7 inches thick. The subsurface layer also is grayish brown, calcareous silt loam. It is about 5 inches thick. The subsoil is light brownish gray, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown and has a few thin strata of darker material. The lower part is very pale brown and has a few thin strata of fine sandy loam.

The nearly level McCook soils formed in weakly stratified, calcareous, loamy alluvium. Typically, the surface layer is grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer also is grayish brown, calcareous silt loam. It is about 8 inches thick. The subsoil is light brownish gray, very friable, calcareous silt loam about 14 inches thick. The upper part of the substratum is light brownish gray silt loam. The lower part to a depth of about 60 inches is very pale brown very fine sandy loam.

The minor soils in this association are the Caruso and Munjor soils on flood plains. Caruso soils are loamy and are moderately well drained. Munjor soils are more sandy than the major soils.

Most of this association is cultivated. A few areas are used as range. Alfalfa, grain sorghum, and wheat are the main dryland crops. Many areas are irrigated. Corn, grain sorghum, alfalfa, and wheat are the main irrigated crops. Wheat is often damaged by flooding in the lower areas. Conserving moisture, controlling flooding, and maintaining tilth and fertility are the main concerns in

managing the cultivated areas. Maintaining the growth and vigor of the desirable grasses is the main concern in managing range.

This association provides a suitable habitat for a variety of wildlife, including deer, pheasant, quail, cottontail rabbit, and many species of nongame birds. Trees, shrubs, and herbaceous plants provide food and cover along the stream channels, stabilize the streambanks, and add vegetative diversity and beauty to the landscape.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bridgeport silt loam, 0 to 2 percent slopes, is a phase of the Bridgeport series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Penden-Canlon loams, 6 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications of series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Bd—Bridgeport silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on low stream terraces and alluvial fans near the larger streams. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to about 1,000 acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 7 inches thick. The subsurface layer also is grayish brown, calcareous silt loam. It is about 5 inches thick (fig. 6). The subsoil is light brownish gray, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown and has a few thin strata of darker material. The lower part is very pale brown and has a few thin strata of fine sandy loam. In some places the surface layer is sandy loam, and in other places it is noncalcareous. In some areas the soil is grayish brown to a depth of more than 20 inches, and in other areas it is noncalcareous to a depth of more than 20 inches.

Permeability and organic matter content are moderate, and runoff is slow. Available water capacity and natural fertility are high. The surface layer is mildly alkaline and friable, and tilth is good.

About 70 percent of the acreage is cultivated. The rest is used as range. Alfalfa is grown in some areas. This soil is well suited to dryland wheat and grain sorghum. Inadequate rainfall and soil blowing are problems if cultivated crops are grown. Summer fallowing conserves moisture. Stubble mulching or other kinds of conservation tillage that leave all or part of the crop residue on the surface help to control soil blowing. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

This soil is well suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Leaving crop residue on the surface increases the rate of water infiltration. Efficient water management

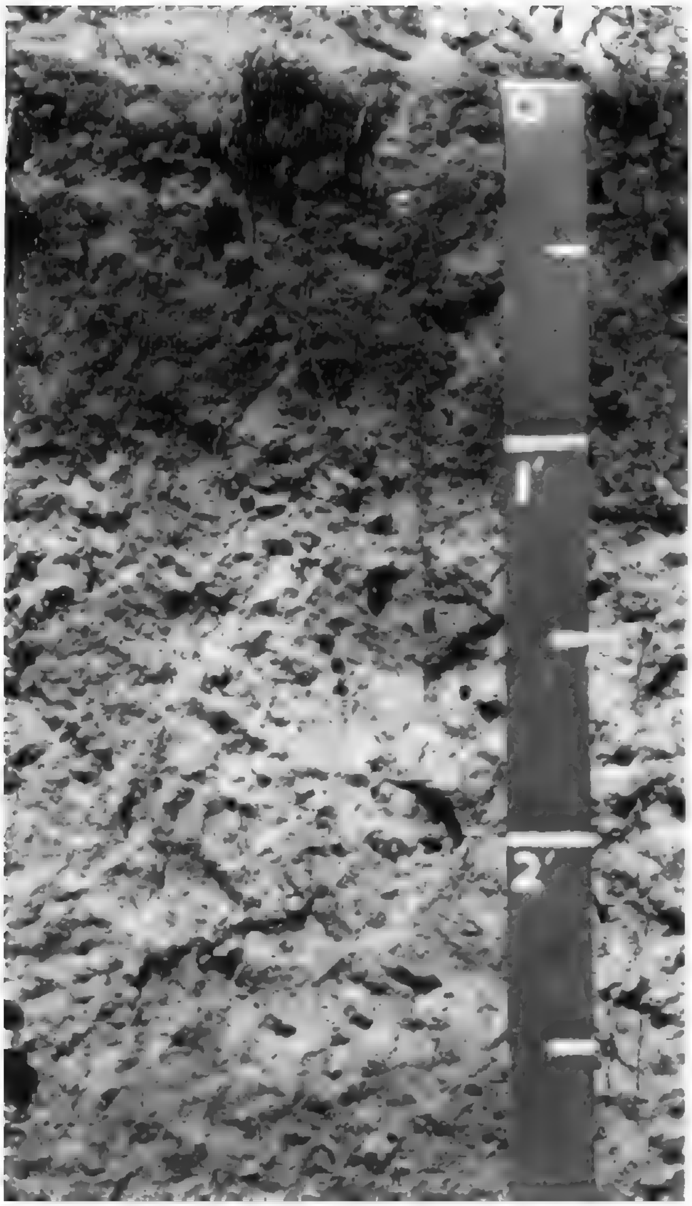

Figure 6.—Typical profile of Bridgeport silt loam, 0 to 2 percent slopes. Organic matter has darkened the soil to a depth of about 12 inches.

is needed. Land leveling and water management improve water distribution.

No major problems affect the use of this soil as range. Soil blowing is a hazard, however, if the range is overgrazed. The native vegetation dominantly is big bluestem, sideoats grama, and western wheatgrass. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as blue grama, buffalograss, and inland saltgrass. Many areas are overgrazed because they are near livestock water and shade trees, where the livestock congregate. Fencing and properly located livestock water, salt, minerals, and feeding areas help to achieve an adequate distribution of grazing. Grazing management that includes a proper stocking rate and a scheduled deferment of grazing during the growing season helps to keep the range productive.

The trees and shrubs that grow along the streams stabilize their banks, beautify the landscape, add vegetative diversity, attract woodland wildlife, and provide permanent food and cover during winter months.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, or other flood-control structures lessen the flooding hazard. Onsite inspection and knowledge of an area's flooding history are needed when building sites are selected. The highest areas on the landscape should be selected as sites for buildings.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields. Levees reduce this hazard. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIc, nonirrigated, and I, irrigated. The range site is Loamy Terrace.

Be—Bridgeport silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream terraces and alluvial fans. Individual areas are irregular in shape and range from 10 to about 80 acres in size.

Typically, the surface soil is grayish brown, calcareous silt loam about 10 inches thick. The subsoil is light brownish gray, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown and has a few thin strata of darker material. The lower part is very pale brown and has a few thin strata of fine sandy loam.

Included with this soil in mapping are small areas of the loamy Penden soils on foot slopes. These soils make up about 5 percent of the map unit.

Permeability and organic matter content are moderate in the Bridgeport soil, and runoff is medium. Available water capacity and natural fertility are high. The surface layer is mildly alkaline and friable, and tilth is good.

About 60 percent of the acreage is cultivated. The rest is used as range. This soil is moderately well suited to dryland wheat and grain sorghum. Water erosion and inadequate rainfall are problems if cultivated crops are grown. Terraces, contour farming, and stubble mulching or other kinds of conservation tillage that leave all or part of the crop residue on the surface conserve moisture and help to prevent excessive soil loss. Summer fallowing also conserves moisture. In some areas diversions are needed to protect the soil against the runoff from the adjacent uplands. Minimizing tillage

and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

This soil is moderately well suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Leaving crop residue on the surface helps to control water erosion and increases the rate of water infiltration. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Efficient water management is needed. If a gravity irrigation system is used, some land leveling generally is needed before the irrigation water can be managed efficiently.

The native vegetation in the areas used as range dominantly is big bluestem, sideoats grama, and western wheatgrass. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as blue grama, buffalograss, and inland saltgrass. Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive. Spraying and winter grazing help to control weeds.

This soil is well suited to dwellings and septic tank absorption fields. Because of the runoff from the adjacent uplands, a diversion may be needed. The soil is only moderately well suited to sewage lagoons because of seepage and the slope. Seepage can be controlled by sealing the floor and walls of the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, nonirrigated and irrigated. The range site is Loamy Terrace.

Ca—Caruso silty clay loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains along some of the larger streams. Areas are long and narrow and range from 10 to 100 acres in size.

Typically, the surface layer is gray, calcareous silty clay loam about 6 inches thick. The subsurface layer is dark grayish brown, calcareous silty clay loam about 12 inches thick. The substratum is calcareous. The upper part is light brownish gray silty clay loam; the next part is pale brown, mottled clay loam; and the lower part to a depth of about 60 inches is very pale brown, mottled loam. In some places the surface layer is light brownish gray. In other places the substratum is not mottled.

Included with this soil in mapping are small areas of the well drained McCook and Munjor soils. These soils are in positions on the landscape similar to those of the Caruso soil. Munjor soils are more sandy than the Caruso soil. Included soils make up about 10 percent of the map unit.

Permeability and organic matter content are moderate in the Caruso soil, and runoff is slow. Available water capacity and natural fertility are high. A seasonal high water table is at a depth of about 2 to 3 feet in spring and summer. The surface layer is moderately alkaline and friable, and tilth is good.

Most areas are used for cultivated crops, but some are used as range. Because of the flooding and the wetness, this soil is only moderately well suited to dryland alfalfa and grain sorghum and is poorly suited to dryland wheat. Planting and harvesting are sometimes delayed by the wetness. Overcoming the flooding hazard is difficult without major flood-control measures. Minimizing tillage and returning crop residue to the soil help to maintain tilth, fertility, and the organic matter content. In some areas diversion terraces are needed to control the runoff from the adjacent uplands.

This soil is well suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Leaving crop residue on the surface increases the rate of water infiltration. Managing water efficiently helps to conserve water.

No major problems affect the use of this soil as range. The flooding and the wetness can be problems, however, in the spring. Grazing when the soil is too wet causes surface compaction. The native vegetation dominantly is big bluestem, switchgrass, and prairie cordgrass. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as western wheatgrass and annual grasses and forbs. Because of the availability of water, the vegetation remains lush and green throughout the growing season. The lush vegetation attracts grazing animals. As a result, special management is needed to prevent overgrazing. Many areas are overgrazed because they are near livestock water and shade trees, where the livestock congregate. Fencing and properly located livestock water, salt, minerals, and feeding areas help to achieve an adequate distribution of grazing. Grazing management that includes a proper stocking rate and a scheduled deferment of grazing during the growing season helps to keep the range productive. Areas of this soil that are managed as hay meadows produce excellent cuttings of native hay.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, nonirrigated and irrigated. The range site is Subirrigated.

Cd—Coly silt loam, 7 to 20 percent slopes. This deep, moderately steep, well drained soil is on side slopes along upland drainageways. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is light brownish gray, calcareous silt loam about 5 inches thick (fig. 7). The subsoil is pale brown, friable, calcareous silt loam about

4 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places erosion has exposed the very pale brown substratum. In other places the surface layer is dark grayish brown and neutral.

Figure 7.—Typical profile of Coly silt loam, 7 to 20 percent slopes. The surface layer is only about 5 inches thick because erosion has kept pace with soil formation.

Included with this soil in mapping are small areas of McCook, Canlon, and Penden soils. The occasionally flooded McCook soils are on bottom land. The shallow Canlon soils and the loamy Penden soils are on the lower side slopes. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Coly soil, and runoff is rapid. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is moderately alkaline.

Nearly all of the acreage is used as range. Because of the hazard of water erosion, this soil generally is unsuited to cultivated crops. It is better suited to range. The native vegetation dominantly is big bluestem, little bluestem, sideoats grama, and blue grama. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as blue grama, buffalograss, tall dropseed, and small soapweed. Water erosion and soil blowing are hazards if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive. Range seeding is needed to restore the productivity of abandoned cropland.

Edge areas where the range adjoins cropland provide good habitat for several kinds of wildlife. Common species include pheasant and cottontail rabbit. The habitat can be improved by planting trees and shrubs or by leaving small areas of unharvested crops.

Because of the slope, this soil is only moderately well suited to dwellings and septic tank absorption fields and generally is unsuited to sewage lagoons. Some land shaping commonly is needed on sites for dwellings. The south-facing slopes may be ideal sites for dwellings that are partly underground. Land shaping and installing the distribution lines on the contour help to ensure that septic tank absorption fields function properly. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is VIe, nonirrigated. The range site is Limy Upland.

Ha—Holdrege silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil mainly is on broad, flats between drainageways in the uplands. Individual areas are irregular in shape and range from 20 to more than 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is friable silty clay loam about 18 inches thick. The upper part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown, and the lower part is very pale brown. In places the soil is grayish brown or darker to a depth of more than 20 inches.

Included with this soil in mapping are small areas of the moderately well drained Pleasant soils in shallow depressions. These soils make up less than 1 percent of the map unit.

Permeability and organic matter content are moderate in the Holdrege soil, and runoff is slow. Available water capacity and natural fertility are high. The surface layer is neutral and friable, and tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all the acreage is used for cultivated crops. This soil is well suited to dryland wheat and grain sorghum. Inadequate rainfall is a problem if cultivated crops are grown. Summer fallowing conserves moisture. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

This soil is well suited to irrigation. Alfalfa, wheat, corn, and grain sorghum are suitable irrigated crops. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Leaving crop residue on the surface increases the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrows reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is moderately well suited to dwellings and sewage lagoons and is well suited to septic tank absorption fields. The moderate shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIc, nonirrigated, and I, irrigated. The range site is Loamy Upland.

He—Holdrege silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil mainly is on divides between drainageways in the uplands. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam about 14 inches thick. The upper part is grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown, and the lower part is very pale brown. In some places the surface layer is silty clay loam. In other places the subsoil is less clayey.

Permeability and organic matter content are moderate, and runoff is medium. Available water capacity and natural fertility are high. The surface layer is neutral and friable, and tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all the acreage is used for cultivated crops. This soil is well suited to dryland wheat and grain sorghum. Water erosion and inadequate rainfall are problems if cultivated crops are grown. Summer fallowing, terraces, contour farming, and stubble mulching or other kinds of conservation tillage that leave all or part of the crop residue on the surface conserve moisture and help to prevent excessive soil loss (fig. 8). Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

This soil is well suited to irrigation. Alfalfa, wheat, corn, and grain sorghum are suitable irrigated crops. Leaving crop residue on the surface helps to control water erosion and increases the rate of water infiltration. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Efficient water management is needed. Land leveling or contour furrows reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is moderately well suited to dwellings and sewage lagoons and is well suited to septic tank absorption fields. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. Seepage and the slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the floor and walls of the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIe, nonirrigated and irrigated. The range site is Loamy Upland.

Mc—McCook silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are long and narrow and generally include the stream channel. They range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer also is grayish brown, calcareous silt loam. It is about 8 inches thick. The subsoil is light brownish gray, very friable, calcareous silt loam about 14 inches thick. The upper part of the substratum is light brownish gray silt loam. The lower part to a depth of about 60 inches is very pale brown very fine sandy loam. In some places the soil is more sandy below a depth of 40 inches. In other places it is grayish brown to a depth of more than 20 inches.

Included with this soil in mapping are small areas of Caruso and Munjor soils. The moderately well drained Caruso soils have a high water table in the spring and

Figure 8.—Stubble mulching, contour farming, and terraces in an area of Holdrege silt loam, 1 to 3 percent slopes.

are in the slightly lower landscape positions. The moderately rapidly permeable Munjor soils generally are adjacent to stream channels and are in the slightly higher positions. Included soils make up less than 5 percent of the map unit.

Permeability and organic matter content are moderate in the McCook soil, and runoff is slow. Available water capacity and natural fertility are high. The surface layer is mildly alkaline and very friable, and tilth is good.

About 70 percent of the acreage is cultivated. The rest is used as range. A narrow band of trees is common along stream channels. Because of the flooding, this soil is only moderately well suited to dryland alfalfa and grain sorghum and is poorly suited to dryland wheat. In some years crop yields are reduced by the flooding, but in other years they may be increased because of the extra moisture. Flooding, inadequate rainfall, and soil blowing are problems if cultivated crops are grown. Overcoming the flooding hazard is difficult without major flood-control measures. Summer fallowing conserves moisture. Stubble mulching or other kinds of conservation tillage that leave all or part of the crop residue on the surface help to control soil blowing. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

Many areas are irrigated. This soil is moderately well suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Leaving crop residue on the surface increases the rate of water infiltration. Efficient water management is needed.

No major problems affect the use of this soil as range. The flooding can be a problem, however, in the spring, and soil blowing is a hazard if the range is overgrazed. The native vegetation dominantly is big bluestem,

switchgrass, and indiangrass. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as blue grama, buffalograss, and inland saltgrass. Many areas are overgrazed because they are near livestock water and shade trees, where the livestock congregate. Fencing and properly located livestock water, salt, minerals, and feeding areas help to achieve an adequate distribution of grazing. Grazing management that includes a proper stocking rate and a scheduled deferment of grazing during the growing season helps to keep the range productive.

The vegetation on this soil includes trees, shrubs, and herbaceous plants that provide food and cover for many kinds of wildlife. The wildlife species include pheasant, quail, deer, cottontail rabbit, raccoon, and nongame birds. The habitat can be improved by planting suitable trees and shrubs.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, nonirrigated and irrigated. The range site is Loamy Lowland.

Mu—Munjor sandy loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along the major streams. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, calcareous sandy loam about 6 inches thick. The subsurface layer also is grayish brown, calcareous sandy loam. It is about 9 inches thick. The substratum is calcareous. The upper part is light brownish gray fine sandy loam; the next part is light gray sandy loam; and the lower part to a depth of about 60 inches is light gray fine sandy loam.

Included with this soil in mapping are small areas of the silty McCook soils. These soils are in positions on the landscape similar to those of the Munjor soil. They make up about 15 percent of the map unit.

Permeability is moderately rapid in the Munjor soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium, and organic matter content is low. The surface layer is mildly alkaline and friable, and tilth is good.

About half of the acreage is used for cultivated crops. The rest is used as range. Because of the flooding, this soil is only moderately well suited to dryland alfalfa and grain sorghum and is poorly suited to dryland wheat. In some years crop yields are reduced because of the flooding, but in other years they can be increased because of the extra moisture. Flooding, soil blowing, and inadequate rainfall are problems if cultivated crops are grown. Overcoming the flooding hazard is difficult without major flood-control measures. Summer fallowing conserves moisture. Stubble mulching or other kinds of conservation tillage that leave all or part of the crop residue on the surface help to control soil blowing. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

This soil is moderately well suited to irrigation. Alfalfa, corn, and grain sorghum are suitable irrigated crops. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Leaving crop residue on the surface increases the rate of water infiltration. Efficient water management is needed.

No major problems affect the use of this soil as range. The flooding can be a problem, however, in the spring, and soil blowing is a hazard if the range is overgrazed. An adequate plant cover helps to control soil blowing. The native vegetation dominantly is sand bluestem, little bluestem, and switchgrass. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as blue grama and western wheatgrass. Many areas are overgrazed because they are near livestock water and shade trees, where the livestock congregate. Fencing and properly located livestock water, salt, minerals, and feeding areas help to achieve an adequate distribution of grazing. Grazing management that includes a proper stocking rate and a scheduled deferment of grazing during the growing season helps to keep the range productive.

The vegetation on this soil includes trees, shrubs, and herbaceous plants that provide food and cover for many kinds of wildlife. The wildlife species include pheasant, quail, deer, cottontail rabbit, raccoon, and nongame birds. The habitat can be improved by planting suitable trees and shrubs.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIIw, nonirrigated and irrigated. The range site is Sandy Lowland.

Ph—Penden-Canlon loams, 6 to 30 percent slopes. These strongly sloping to steep soils are on upland side slopes along deeply dissected drainageways. The deep, well drained Penden soil is in the less sloping areas. The shallow, somewhat excessively drained Canlon soil is in the steeper areas at midslope, generally near rock outcrops. Individual areas are long and narrow and range from 10 to several hundred acres in size. They are about 45 percent Penden soil and 30 percent Canlon soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Penden soil has a surface layer of grayish brown, calcareous loam about 8 inches thick. The subsurface layer is brown, calcareous clay loam about 8 inches thick. The subsoil is very pale brown, friable, calcareous clay loam about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam. In places the surface soil and subsoil are sandy loam.

Typically, the Canlon soil has a surface layer of grayish brown, calcareous loam about 4 inches thick. The subsoil is pale brown, friable, calcareous loam about 5 inches thick. The substratum is light brownish gray, friable, calcareous gravelly loam. Hard caliche is at a depth of about 14 inches. In places the surface layer and substratum are clay loam or sandy loam.

Included with these soils in mapping are small areas of the deep, silty McCook and Coly soils and small areas of rock outcrop. McCook soils are on narrow flood plains. Coly soils are on the upper side slopes. The rock outcrop is caliche. It is on the steeper side slopes. Included areas make up about 25 percent of the map unit.

Permeability is moderate in the Penden and Canlon soils. Runoff is rapid on the Canlon soil and medium on the Penden soil. Available water capacity is low in the Canlon soil and high in the Penden soil. Root penetration is restricted by the bedrock below a depth of about 14 inches in the Canlon soil. Natural fertility is low in the Canlon soil and high in the Penden soil. Organic matter content is moderate in the Penden soil and low in the Canlon soil. The shrink-swell potential is moderate in the Penden soil.

Nearly all of the acreage is used as range. Because of the hazard of water erosion on both soils and the shallowness to hard caliche in the Canlon soil, these soils generally are unsuited to cultivated crops. They are better suited to range. The native vegetation dominantly is big bluestem, little bluestem, and sideoats grama. Sideoats grama is more extensive on the shallow Canlon soil than on the Penden soil. In areas that are continually overgrazed, the dominant native grasses are replaced by less productive plants, such as buffalograss, hairy grama, and western wheatgrass. The grasses on these soils commonly are grazed less intensively than those on adjacent soils that are less sloping and are more accessible to livestock. Water erosion and soil blowing can be hazards if the range is overgrazed. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing. Grazing management that includes a proper stocking rate and a scheduled deferment of grazing during the growing season helps to keep the range productive.

Edge areas where the range adjoins cropland provide good habitat for such wildlife as pheasant, quail, and cottontail rabbit.

The Penden soil generally is unsuited to sewage lagoons and is moderately well suited to dwellings and septic tank absorption fields. The slope is a limitation affecting these uses. Also, the shrink-swell potential is a limitation on sites for buildings, and the moderate permeability is a limitation in septic tank absorption fields. Because of the slope, building sites should be improved by land shaping and the lateral lines in septic tank absorption fields should be installed on the contour. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderate permeability can be overcome by increasing the size of the absorption field.

The Canlon soil generally is unsuited to building site development because of the slope and the shallow depth to bedrock.

The land capability classification is VIe, nonirrigated. The Penden soil is in the Limy Upland range site, and the Canlon soil is in the Shallow Limy range site.

Ps—Pleasant silty clay loam. This deep, nearly level, moderately well drained soil is in upland depressions. It is frequently ponded by runoff from the adjacent areas in fall and spring. Individual areas are irregular in shape and range from 3 to 30 acres in size.

Typically, the surface layer is gray silty clay loam about 11 inches thick. The subsoil is about 33 inches thick. The upper part is dark gray, extremely firm silty clay; the next part is grayish brown, very firm silty clay loam; and the lower part is light brownish gray, firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer and subsoil are calcareous silty clay.

Permeability is very slow. Available water capacity and organic matter content are moderate. Natural fertility is high. Runoff is ponded. A perched seasonal high water table is at or above the surface in spring and summer. The surface layer is slightly acid and firm, and tilth is fair. The shrink-swell potential is high in the subsoil.

Nearly all areas are cultivated along with the surrounding areas. Because of the ponding, this soil is poorly suited to wheat and grain sorghum. Stubble mulching, terraces, and contour farming on the surrounding soils help to control ponding on this soil. Soil blowing is a hazard during dry periods. It can be controlled by stubble mulching or by other kinds of conservation tillage that leave all or part of the crop residue on the surface.

The ponding on this soil results in shallow water areas that can be used as habitat by waterfowl and other kinds of wildlife. The cultivated crops in the adjacent areas provide food and nesting sites.

This soil generally is unsuited to building site development because of the ponding.

The land capability classification is IVw, nonirrigated. The range site is Clay Upland.

Ub—Uly silt loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on the upper side slopes along drainageways in the uplands. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil

is pale brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the surface layer is calcareous, and in other places it is lighter in color.

Included with this soil in mapping are small areas of the calcareous, loamy Penden soils. These soils are in positions on the landscape similar to those of the Uly soil. They make up less than 5 percent of the map unit.

Permeability and organic matter content are moderate in the Uly soil, and runoff is medium. Available water capacity and natural fertility are high. The surface layer is neutral and friable, and tilth is good.

About 50 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to dryland wheat and grain sorghum. Grain sorghum is susceptible to chlorosis because the soil has a high content of lime, which ties up plant nutrients. Some herbicides may create carry-over problems because of the high pH. Water erosion and inadequate rainfall are problems if cultivated crops are grown. Terraces, contour farming, and stubble mulching or other kinds of conservation tillage that leave all or part of the crop residue on the surface conserve moisture and help to prevent excessive soil loss. Summer fallowing also conserves moisture. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

Some areas are irrigated by sprinklers. This soil is poorly suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Also, some wheat is grown. Leaving crop residue on the surface helps to control water erosion and increases the rate of water infiltration. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Efficient water management is needed.

The native vegetation in the areas used as range dominantly is big bluestem, little bluestem, and sideoats grama. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as blue grama, buffalograss, and western wheatgrass. Water erosion is a hazard if the range is overgrazed. An adequate plant cover helps to prevent excessive soil loss. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive. Well distributed salting and watering facilities help to obtain a uniform distribution of grazing.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because of seepage and the slope. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction. Sealing the floor and walls of the lagoon helps to control seepage.

The land capability classification is IIIe, nonirrigated and irrigated. The range site is Loamy Upland.

Uc—Uly silt loam, 4 to 9 percent slopes, eroded. This deep, strongly sloping, well drained soil is on the upper side slopes along drainageways in the uplands. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface soil is grayish brown silt loam about 7 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In places erosion has exposed the calcareous subsoil or substratum.

Included with this soil in mapping are small areas of Canlon and Penden soils and small areas of rock outcrop. The shallow Canlon soils are on the lower side slopes. The loamy Penden soils are in positions on the landscape similar to those of the Uly soil. The rock outcrop is caliche. It is on the steeper side slopes. Included areas make up about 15 percent of the map unit.

Permeability is moderate in the Uly soil, and runoff is medium. Available water capacity is high, and natural fertility is medium. Organic matter content is moderate. The surface layer is mildly alkaline and friable, and tilth is good.

About 70 percent of the acreage is cultivated. Some areas have been reseeded to native grasses. This soil is poorly suited to dryland wheat and grain sorghum. Sorghum is susceptible to chlorosis because the soil has a high content of lime. Some herbicides may create carry-over problems because of the high pH. Further water erosion and inadequate rainfall are problems if cultivated crops are grown. Terraces, contour farming, and stubble mulching or other kinds of conservation tillage that leave all or part of the crop residue on the surface conserve moisture and help to prevent excessive soil loss. Summer fallowing also conserves moisture. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility.

A few areas are irrigated by sprinklers. This soil is poorly suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Some wheat also is grown. Minimizing tillage and returning crop residue to the soil help to maintain the organic matter content, tilth, and fertility. Leaving crop residue on the surface helps to control water erosion and increases the rate of water infiltration. Efficient water management is needed.

The native vegetation in the areas used as range dominantly is big bluestem, little bluestem, and sideoats grama. In areas that are continually overgrazed, these grasses are replaced by less productive plants, such as blue grama, buffalograss, and western wheatgrass. Further water erosion is a hazard if the range is overgrazed. An adequate plant cover reduces the runoff

rate and the susceptibility to water erosion. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive. Well distributed salting and watering facilities help to obtain a uniform distribution of grazing.

This soil is well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage and the slope. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction. Sealing the floor and walls of the lagoon helps to control seepage.

The land capability classification is IVe, nonirrigated and irrigated. The range site is Loamy Upland.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 412,840 acres in the survey area, or 72 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern part and along the major streams, mainly in the Holdrege-Uly and Bridgeport-McCook associations, which are described under the heading "General Soil Map Units." Winter wheat, grain sorghum, and corn are the main dryland crops grown on this land. About 12,000 acres of the prime farmland is used for irrigated corn, grain sorghum, alfalfa, or soybeans. Most of the dryland and irrigated corn, grain sorghum, and alfalfa is used locally as feed for livestock.

The map units in the survey area that are considered prime farmland are listed at the end of this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The map units that meet the requirements for prime farmland are:

Bd	Bridgeport silt loam, 0 to 2 percent slopes
Be	Bridgeport silt loam, 2 to 5 percent slopes
Ca	Caruso silty clay loam, occasionally flooded
Ha	Holdrege silt loam, 0 to 1 percent slopes
He	Holdrege silt loam, 1 to 3 percent slopes
Mc	McCook silt loam, occasionally flooded
Mu	Munjor sandy loam, occasionally flooded
Ub	Uly silt loam, 3 to 7 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, and trees and shrubs.

The soils in the survey area are assigned to a land capability classification and a range site at the end of each map unit description and in tables 5 and 6. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops

Jerry B. Lee, conservation agronomist, Soil Conservation Service, assisted in preparing this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 349,000 acres in Decatur County, or 61 percent of the total acreage, is used for cultivated crops or is summer fallowed. During the period 1971 to 1981, wheat was grown on about 35 percent of the cropland, grain sorghum on 10 percent, corn on 3 percent, and alfalfa on 3 percent (*3*). About 34 percent of the cropland was summer fallowed, and 15 percent either was unharvested or was used for minor crops, such as sunflowers, rye, or barley. During this period, the acreage used for grain sorghum decreased and the acreage used for wheat increased compared to the acreage used for these crops during the previous 10-year period. The acreage of all other crops remained about the same.

Crop production can be increased on most farms by applying the latest technology. This soil survey can facilitate the application of such technology. A system of soil management consists of a combination of practices used to produce crops and grasses. The main concerns in managing the soils in Decatur County are controlling erosion and soil blowing, making the most efficient use of irrigation water, conserving soil moisture, and maintaining fertility and tilth.

Soil blowing and inadequate rainfall are hazards on all of the cropland in Decatur County. Erosion is a hazard on about 40 percent of the cropland. Most of the erosion occurs on soils that have a slope of more than 1 or 2 percent. Examples are Bridgeport, Holdrege, Penden, and Uly soils.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the

surface layer is lost and part of the subsoil is incorporated into the plow layer. Secondly, erosion pollutes streams with sediment, nutrients, and pesticides. Control of erosion minimizes the pollution of streams and improves the quality of water.

Erosion-control practices provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and preserves the productive capacity of the soils.

Terraces and diversions shorten the length of slopes, reduce the runoff rate, and help to control erosion. They are most practical on deep, well drained soils that have uniform slopes. Contour farming generally should be used in combination with terraces. It is best suited to those soils that have smooth, uniform slopes and are suitable for terracing.

Conservation tillage leaves all or part of the crop residue on the surface. An example is stubble mulching. Drilled crops, such as small grain, are alternated with row crops in conservation cropping systems. Both conservation tillage and conservation cropping systems are helping to control erosion and soil blowing in Decatur County.

Because of inadequate rainfall in most years, measures that increase the supply of soil moisture are needed on the cropland in the county. Examples are stubble mulching, summer fallowing, and terraces. Stubble mulching and terraces reduce the runoff rate. Also, stubble mulching traps snow. Summer fallowing allows the land to lie idle during the summer and thus increases the supply of moisture for the growth of succeeding crops.

Efficient water management is needed in irrigated areas. Land leveling and contour furrowing reduce the runoff rate and improve water distribution in areas that are irrigated by a flooding system. Tailwater pits help to recover runoff. If a sprinkler system is used, the runoff rate can be reduced by matching the water application rate to the infiltration rate of the soil. Timely applications and water management that prevents overirrigating conserve water in areas irrigated by either a flooding or a sprinkler system.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizers. On all soils the amount of fertilizer to be applied should be based on the results of soil tests, on the needs of the crop, on the expected level of yields, and on the experience of farmers. The Cooperative Extension Service can help to determine the kind and amount of fertilizer needed.

Organic matter is a storehouse of available plant nutrients. It increases the water intake rate, helps to prevent surface crusting, helps to control erosion, and promotes good tilth. Most of the soils in the county that are used for crops have a silt loam surface layer. Intensive rainfall causes surface crusting. When dry, surface crust becomes nearly impervious to water. As a result, the runoff rate is increased. Regularly adding organic matter and leaving crop residue on the surface minimize surface crusting, increase the rate of water infiltration, and reduce the runoff rate and the hazard of erosion.

Information about the design of erosion-control practices is available in the local office of the Soil Conservation Service. The latest information about growing crops can be obtained from the Cooperative Extension Service or the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Rangeland

Loren J. Pearson, range conservationist, Soil Conservation Service, assisted in preparing this section.

About 210,000 acres in Decatur County, or nearly 37 percent of the total acreage, is range. The range is distributed throughout the county but generally is adjacent to drainage systems and in the steeper areas that are difficult to farm. About 49,200 head of livestock utilize this range resource (*3*). Cow-calf enterprises are dominant in the county; however, some ranchers have stocker type enterprises. Also, several thousand head are full fed each year. The native range is well suited to all of these livestock enterprises.

The range supports essentially the same grass species that it supported 100 years ago. Changes in the plant community are due to environmental changes of cultural influences. Proper grazing management can improve the range and maintain forage production.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre

of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Native Woodland, Windbreaks, and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, assisted in preparing this section.

Native woodland in Decatur County occurs only along the major streams or rivers in areas of the Bridgeport-McCook soil association, mainly in narrow bands along Beaver Creek, Sappa Creek, Prairie Dog Creek, and the North Fork of the Solomon River. Boxelder, green ash, and eastern cottonwood are the dominant species. Other species are American elm, hackberry, peachleaf willow, red mulberry, black walnut, honeylocust, American plum, common chokecherry, golden currant, false indigo, American elder, and smooth sumac. The understory trees mainly are green ash and hackberry.

The upland drainageways in the county support very few trees. Some wet spots in the drainageways support single trees or small clumps of eastern cottonwood, peachleaf willow, elm, green ash, and boxelder.

Trees in the wooded areas can be used for firewood and other wood products. They are in scattered areas, however, and are not in large enough concentrations to be of commercial value.

Trees grow on most of the farmsteads and ranch headquarters in Decatur County. Some of these are windbreaks, but most are environmental or ornamental plantings. Siberian elm and eastern redcedar are the most common species in the windbreaks (fig. 9). Other commonly planted species are Rocky Mountain juniper, honeylocust, Russian-olive, eastern cottonwood, Austrian pine, ponderosa pine, blue spruce, green ash, hackberry, boxelder, silver maple, lilac, and tamarisk.

Tree planting is a continual need because old trees pass maturity and deteriorate, because some trees are destroyed by insects, disease, or storms, and because new plantings are needed on expanding farmsteads. Windbreak renovation practices, such as removal and replacement or supplemental planting, help to maintain the effectiveness of the windbreaks.

In order for windbreaks and environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Permeability, available water capacity, fertility, soil depth, and texture greatly affect the growth rate.

Trees are difficult to establish in the county. The survival rate may be restricted by competition from weeds and grasses and by a scarcity of water. The main management needs are proper site preparation before the trees and shrubs are planted and measures that control the competing weeds and grasses after the trees and shrubs are planted. Supplemental watering is necessary during extended dry periods.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Figure 9.—Windbreak of eastern redcedar on Holdrege silt loam, 1 to 3 percent slopes.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, assisted in preparing this section.

Decatur County has several areas of scenic, geologic, and historic interest. The countryside offers scenic views of growing crops, rolling grassland, and rocky bluffs. Pheasants, wild turkeys, cottontail rabbits, and deer are throughout the county. The pheasant season attracts many hunters to the county.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil

properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, assisted in preparing this section.

The primary game species in Decatur County are pheasant, bobwhite quail, cottontail rabbit, white-tailed deer, and mule deer. Mourning doves, fox squirrels, prairie chickens, and turkeys also are hunted but on a limited basis. Some coyotes, raccoons, and opossum are trapped in the county.

Nongame species are numerous because of the diverse habitat types in the county. Cropland, woodland, and grassland are intermixed throughout the county. This intermixture creates the desirable edge effect conducive to a variety of wildlife species. Establishing additional fringe areas generally increases the wildlife population. A good windbreak commonly provides winter cover for several pheasants and cottontail rabbits, a covey of quail, and many songbirds.

Fishing is limited in Decatur County to a few farm ponds and sand pits. The species commonly caught are channel catfish, bullheads, bass, and bluegill.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth

of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestems, goldenrod, switchgrass, wheatgrass, ragweed, sunflowers, native legumes, and gramas.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are golden currant, plum, fragrant sumac, prairie rose, and sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, arrowhead, saltgrass, prairie cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, mourning dove, meadowlark, field sparrow, cottontail rabbit, and coyote.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, redwing blackbirds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, meadowlark, lark bunting, pheasant, horned lark, killdeer, badger, jackrabbit, and hawks.

Technical assistance in planning wildlife developments and in determining the vegetation suitable for planting can be obtained from the Soil Conservation Service office. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

John A. Eberwein, civil engineer, Soil Conservation Service, assisted in preparing this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5)

plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly

permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable

compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 10). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

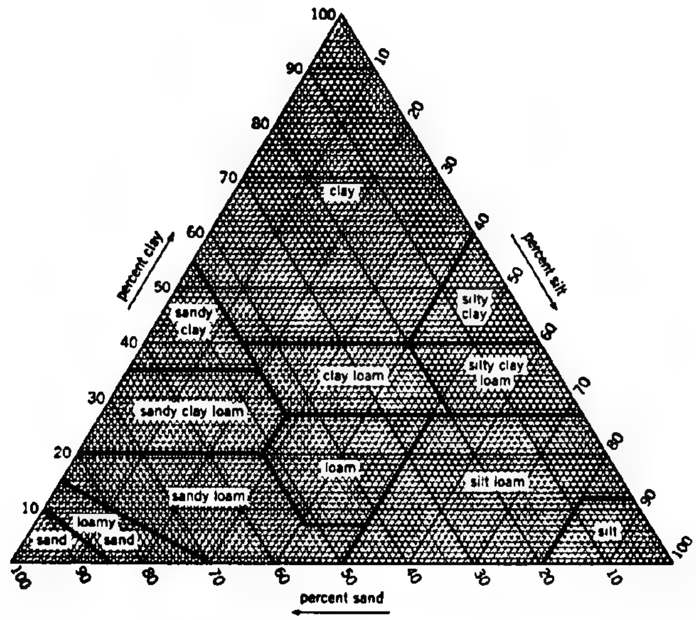

Figure 10.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content

of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay

minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or

soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey

area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is typical for the great group. An example is Typic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*4*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*5*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bridgeport Series

The Bridgeport series consists of deep, well drained, moderately permeable soils on stream terraces and alluvial fans. These soils formed in calcareous, silty alluvium. Slope ranges from 0 to 5 percent.

Bridgeport soils are commonly adjacent to Caruso, Coly, McCook, Munjor, and Penden soils. The moderately well drained Caruso soils are more sandy than the Bridgeport soils and are on flood plains. Coly soils do not have a mollic epipedon and are on uplands. McCook soils have less clay throughout than the Bridgeport soils and are on flood plains. Munjor soils are

more sandy than the Bridgeport soils and are on flood plains. The loamy Penden soils are on uplands.

Typical pedon of Bridgeport silt loam, 0 to 2 percent slopes, 1,600 feet west and 100 feet south of the northeast corner of sec. 3, T. 2 S., R. 30 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; few fine and medium roots; few worm casts; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—7 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; few fine roots; few worm casts; strong effervescence; mildly alkaline; clear smooth boundary.

Bw—12 to 23 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; few worm casts; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—23 to 35 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; hard, friable; few fine roots; few worm casts; few thin strata of darker material; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—35 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few worm casts; few thin strata of fine sandy loam in the lower part; violent effervescence; moderately alkaline.

The solum ranges from 10 to 30 inches in thickness. It is mildly alkaline or moderately alkaline. The depth to lime ranges from 0 to 15 inches. Some pedons have an AC horizon and a buried A horizon. Some pedons do not have a Bw horizon.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It dominantly is silt loam, but the range includes fine sandy loam, loam, clay loam, and silty clay loam. The Bw horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is loam, silt loam, or silty clay loam. Strata that are more sandy, more clayey, or mottled are below a depth of 40 inches in some pedons.

Canlon Series

The Canlon series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from lime-cemented sandstone or caliche. Slope ranges from 6 to 30 percent.

Canlon soils are commonly adjacent to Coly, Penden, and Uly soils. The adjacent soils are more than 40 inches deep over bedrock. Coly and Uly soils are higher on the landscape than the Canlon soils. Penden soils are on side slopes above or below the Canlon soils.

Typical pedon of Canlon loam, in an area of Penden-Canlon loams, 6 to 30 percent slopes, 2,200 feet north and 150 feet east of the southwest corner of sec. 3, T. 4 S., R. 27 W.

A—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

AC—4 to 9 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; hard, friable; many fine roots; many worm casts; about 10 percent caliche fragments less than 1/4 inch in size; violent effervescence; moderately alkaline; gradual smooth boundary.

C—9 to 14 inches; light brownish gray (10YR 6/2) gravelly loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; many small to large fragments of caliche; violent effervescence; moderately alkaline; abrupt wavy boundary.

R—14 inches; white hard caliche.

The thickness of the solum ranges from 3 to 12 inches. The depth to hard caliche bedrock ranges from 10 to 20 inches. The soils are loam, fine sandy loam, or gravelly loam throughout, and the content of coarse fragments ranges from 0 to 35 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. The C horizon has hue of 10YR, value of 6 to 8 (5 to 7 moist), and chroma of 2 or 3.

Caruso Series

The Caruso series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Caruso soils are commonly adjacent to McCook soils. The silty McCook soils are well drained and are in positions on the landscape similar to those of the Caruso soils.

Typical pedon of Caruso silty clay loam, occasionally flooded, 2,500 feet south and 50 feet west of the northeast corner of sec. 33, T. 1 S., R. 30 W.

A1—0 to 6 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; hard, friable; many fine roots;

strong effervescence; moderately alkaline; clear smooth boundary.

A2—6 to 18 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; slightly hard, friable; many fine roots; few worm casts; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—18 to 26 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—26 to 30 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; few fine faint yellowish brown (10YR 5/6) mottles; weak fine and medium granular structure; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—30 to 42 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; few fine faint brownish yellow (10YR 6/6) mottles; massive; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C4—42 to 60 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; few or common faint yellowish brown (10YR 5/8) mottles; massive; slightly hard, friable; few fine roots; few thin strata of sandy loam; strong effervescence; moderately alkaline.

The thickness of the solum and of the mollic epipedon ranges from 7 to 20 inches. The depth to free carbonates ranges from 0 to 10 inches. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It dominantly is silty clay loam, but the range includes loam, sandy loam, clay loam, and silt loam. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 to 7 (3 to 5 moist), and chroma of 1 to 3. In the lower part this horizon commonly is mottled with colors of higher chroma and lower value. It is loam, silt loam, silty clay loam, or clay loam. Contrasting strata of sandy or clayey material are below a depth of 40 inches in some pedons.

Coly Series

The Coly series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 7 to 20 percent.

Coly soils are similar to Uly soils and are commonly adjacent to Canlon, Penden, and Uly soils. Uly and Penden soils have a mollic epipedon. Canlon soils are 10 to 20 inches deep over bedrock. Canlon and Penden soils are lower and Uly soils are higher on the landscape than the Coly soils.

Typical pedon of Coly silt loam, 7 to 20 percent slopes, 700 feet north and 2,200 feet west of the southeast corner of sec. 10, T. 3 S., R. 28 W.

A—0 to 5 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; many worm casts; strong effervescence; moderately alkaline; clear smooth boundary.

AC—5 to 9 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate fine granular structure; slightly hard, friable; many fine roots; many worm casts; strong effervescence; moderately alkaline; clear smooth boundary.

C—9 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; few fine roots; few worm casts; few fine soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 3 to 12 inches. Typically, lime is throughout the profile, but some pedons do not have lime in the upper 6 inches. The soils are mildly alkaline or moderately alkaline silt loam or loam throughout.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. The AC and C horizons have hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Holdrege Series

The Holdrege series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 0 to 3 percent.

Holdrege soils are similar to Uly soils and are commonly adjacent to those soils. Uly soils do not have an argillic horizon. They are more sloping than the Holdrege soils and are commonly lower on the landscape.

Typical pedon of Holdrege silt loam, 1 to 3 percent slopes, 860 feet south and 1,000 feet west of the northeast corner of sec. 18, T. 5 S., R. 26 W.

Ap—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; slightly hard, friable; many fine roots; neutral; abrupt smooth boundary.

A—4 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; neutral; clear smooth boundary.

Bt1—10 to 18 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure;

slightly hard, friable; thin discontinuous clay films; few fine roots; neutral; gradual smooth boundary.

Bt2—18 to 24 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable; thin discontinuous clay films; few fine roots; mildly alkaline; gradual smooth boundary.

C1—24 to 38 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, friable; few fine soft masses of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—38 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; few fine roots; strong effervescence; moderately alkaline.

The solum ranges from 16 to 48 inches in thickness. It is silt loam or silty clay loam. The mollic epipedon ranges from 8 to 20 inches in thickness. The depth to lime ranges from 15 to 30 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The Bt horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR, value of 6 to 8 (5 or 6 moist), and chroma of 2 to 4.

McCook Series

The McCook series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

McCook soils are commonly adjacent to Bridgeport, Caruso, and Munjor soils. Bridgeport soils have more clay throughout than the McCook soils and are on stream terraces. The somewhat poorly drained Caruso soils and the sandy Munjor soils are in positions on the landscape similar to those of the McCook soils.

Typical pedon of McCook silt loam, occasionally flooded, 1,700 feet north and 100 feet west of the southeast corner of sec. 19, T. 1 S., R. 29 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—6 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable; many fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

AC—14 to 28 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak fine granular; soft, very friable; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C1—28 to 40 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; few fine roots; fine strata in the upper part; strong effervescence; moderately alkaline; clear smooth boundary.

C2—40 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 33 inches. The thickness of the mollic epipedon ranges from 10 to 16 inches. The depth to free carbonates is less than 10 inches, and most pedons are calcareous at or near the surface. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but the range includes very fine sandy loam, loam, fine sandy loam, and clay loam. The AC and C horizons have hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of dominantly 2 or 3. Some strata have chroma of 1. These horizons typically are silt loam or very fine sandy loam, but the range includes loam. In most pedons buried soils or thin strata of slightly coarser or finer textured material are in the C horizon. Some pedons have coarse sand, gravelly sand, or both below a depth of 40 inches. Faint mottles are below a depth of 30 inches in some pedons.

Munjor Series

The Munjor series consists of deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Munjor soils are commonly adjacent to McCook soils. The silty McCook soils have a mollic epipedon and are in positions on the landscape similar to those of the Munjor soils.

Typical pedon of Munjor sandy loam, occasionally flooded, 2,200 feet west and 300 feet north of the southeast corner of sec. 28, T. 4 S., R. 27 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; few fine roots; few fine pebbles; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—6 to 15 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, friable; few fine roots; few fine pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

C1—15 to 28 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, friable; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.
C2—28 to 42 inches; light gray (10YR 7/2) sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.
C3—42 to 60 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 20 inches. The depth to lime is less than 10 inches. Stratification in the C horizon occurs as small variations in color and sand content. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. It dominantly is sandy loam, but the range includes loamy sand, loamy fine sand, fine sandy loam, and loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is dominantly sandy loam, fine sandy loam, or loamy sand. In some pedons, however, the upper part of this horizon has a few strata of loamy fine sand or the lower part is sand.

Penden Series

The Penden series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium. Slope ranges from 6 to 15 percent.

Penden soils are commonly adjacent to Bridgeport, Canlon, Coly, and Uly soils. The silty Bridgeport soils are on stream terraces and alluvial fans. Canlon soils are 10 to 20 inches deep over bedrock and are steeper than the Penden soils. Coly and Uly soils have a silty subsoil and are higher on the landscape than the Penden soils.

Typical pedon of Penden loam, in an area of Penden-Canlon loams, 6 to 30 percent slopes, 1,250 feet north and 1,250 feet east of the southwest corner of sec. 15, T. 2 S., R. 27 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; weak effervescence; mildly alkaline; clear smooth boundary.
A2—8 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure; slightly hard, friable; many fine roots; many worm casts; few fine soft masses of lime; strong effervescence; moderately alkaline; clear smooth boundary.
Bk—16 to 25 inches; very pale brown (10YR 8/3) clay loam, pale brown (10YR 6/3) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; many small soft masses and coatings of lime; violent effervescence; moderately alkaline; gradual smooth boundary.
C—25 to 60 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few small soft masses of lime; violent effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. The mollic epipedon ranges from 7 to 20 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is loam or clay loam. The Bk horizon has hue of 10YR or 7.5YR, value of 4 to 8 (3 to 6 moist), and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR, value of 5 to 8 (4 to 7 moist), and chroma of 2 to 4. It is clay loam or loam.

Pleasant Series

The Pleasant series consists of deep, moderately well drained, very slowly permeable soils in small upland depressions a few inches to several feet below the surrounding areas. These soils formed in silty and clayey alluvium. Slope is 0 to 1 percent.

Pleasant soils are commonly adjacent to Holdrege soils. The well drained Holdrege soils have less clay in the subsoil than the Pleasant soils and are slightly higher on the landscape.

Typical pedon of Pleasant silty clay loam, 2,500 feet east and 300 feet north of the southwest corner of sec. 22, T. 1 S., R. 30 W.

A—0 to 11 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, firm; few fine roots; slightly acid; abrupt smooth boundary.
Bt1—11 to 30 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, extremely firm; clay films and few glossy coatings on faces of peds; few fine roots; slightly acid; clear smooth boundary.
Bt2—30 to 40 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, very firm; clay films on faces of peds; mildly alkaline; clear smooth boundary.
Btk—40 to 44 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; few fine threads and soft

masses of lime; strong effervescence; moderately alkaline; clear smooth boundary.

C—44 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to lime range from 30 to more than 50 inches. The mollic epipedon ranges from 20 to 50 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It dominantly is silty clay loam, but the range includes silty clay and silt loam. The Bt horizon has hue of 10YR, value of 4 to 7 (2 to 6 moist), and chroma of 1 to 3. It is silty clay loam, silty clay, or clay. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 5. Some pedons have dark buried horizons below a depth of 40 inches.

Uly Series

The Uly series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 3 to 9 percent.

Uly soils are similar to Coly and Holdrege soils and are commonly adjacent to those soils and to Penden soils. Coly soils do not have a mollic epipedon and are on the steeper slopes, generally below the Uly soils. Holdrege soils have an argillic horizon and are generally higher on the landscape than the Uly soils. The loamy Penden soils are on the lower side slopes.

Typical pedon of Uly silt loam, 3 to 7 percent slopes, 3,600 feet north and 200 feet east of the southwest corner of sec. 33, T. 4 S., R. 27 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; many worm casts; neutral; clear smooth boundary.

A2—4 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; few worm casts; neutral; clear smooth boundary.

Bw—11 to 19 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; few fine soft masses and threads of lime; violent effervescence; moderately alkaline; gradual smooth boundary.

C—19 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; violent effervescence; moderately alkaline.

The solum ranges from 10 to 24 inches in thickness. It is silt loam or silty clay loam. The depth to lime ranges from 7 to 15 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The Bw horizon has hue of 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. Some pedons have a Bk horizon. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of a soil at any given point are determined by the interaction of five factors of soil formation: 1) the physical and mineralogical composition of the parent material, 2) the climate under which the soil material has accumulated and existed since accumulation, 3) the plant and animal life on and in the soil, 4) the relief, and 5) the length of time that the forces of soil formation have acted on the soil material. Each of these factors influences the formation of every soil, and each modifies the effects of the other four. The relative effects of the individual factors vary from place to place. The interactions among the factors are more complex for some soils than for others.

Parent Material

Parent material is the unconsolidated material in which soils form. It either is material weathered from rocks through freezing and thawing, abrasion, erosion, or chemical processes or is weathered material deposited by wind or water. The parent material affects texture, structure, color, natural fertility, and many other soil properties. Soils differ partly because of the various kinds of parent material. The texture of the parent material influences the rate of the downward movement of water and air and thus greatly affects soil formation. The composition of the parent material largely determines the mineralogical composition of the soil and, hence, its natural fertility.

The soils in Decatur County formed in loess, old alluvium, recent alluvium, and residuum.

The soils that formed in loess are the most extensive soils in the county. These are the Coly, Holdrege, and Uly soils. The loess is porous, calcareous silt loam that is more than 50 percent silt and less than 15 percent fine sand or coarser sand. It is many feet thick throughout much of the county.

Old alluvium and recent alluvium are sediments that have been transported by water. The old alluvium is on uplands. It either is of the Ogallala Formation, which is Tertiary in age, or is Pleistocene-age material. Penden soils formed in old alluvium. The recent alluvium is on flood plains and stream terraces. Bridgeport, Caruso, McCook, and Munjor soils formed in this material.

The bedrock that crops out in the county is dominantly lime-cemented sandstone or caliche. Canlon soils formed in material weathered from this calcareous material.

Climate

Climate directly affects soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plants and animals.

The climate of Decatur County is typical continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. Because of the wetting and drying, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of some soils.

Plant and Animal Life

Plants and animals have important effects on soil formation. Plants generally influence the amount of nutrients and organic matter in the soil and the color of the surface layer. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous. Earthworms have left many worm casts in some soils. Bacteria and fungi help to decompose the plants, thus releasing plant nutrients.

The mid and tall prairie grasses have had the greatest effect on soil formation in Decatur County. As a result of the grasses, the upper part of a typical soil in the county is dark and is high in content of organic matter. The transitional part in many areas is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color and high in content of lime.

Relief

Relief, or lay of the land, influences the formation of soils through its effects on drainage, runoff, plant cover, and soil temperature. Although climate and plants are the most active factors of soil formation, relief also is important, mainly because it controls the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper upland soils than on the less sloping soils. As a result, erosion is more extensive. Penden and Canlon soils formed in old parent material, but relief has restricted their formation. Runoff is medium or rapid on these strongly sloping to steep soils, and much of the soil material is removed as soon as the soil forms.

Runoff is slow on the nearly level Bridgeport soils, which formed in recent alluvium on stream terraces. Most of the precipitation received penetrates the surface. As a result, these soils have a darkened horizon from which some lime has been leached.

Time

The length of the time that the soil material has been subject to weathering and the soil-forming processes is commonly reflected in the degree of profile development. Soils that do not have distinct horizons are considered young, whereas those that have distinct horizons are considered old, or mature.

The soils in Decatur County range from immature to mature. Young soils, such as Bridgeport and McCook soils, are on bottom land that is subject to stream overflow. They receive new sediment with each flood. They have been in place long enough to develop a thick, dark surface layer, but little or no clay has moved downward through the profile. In contrast, the mature Holdrege soils have very distinct horizons. Much of the clay has been translocated to the subsoil. Thousands of years are needed for such stages of horizon development.

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Glossary

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:
O horizon.—An organic layer of fresh and decaying plant residue.
A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.
E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.
B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.
C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.
Cr horizon.—Soft, consolidated bedrock beneath the soil.
R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They

have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10

square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05

millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Data were recorded in the period 1941-70 at Oberlin, Kansas)

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	42.8	13.4	28.1	71	-15	0.46	.10	0.66	1	4.8
February---	47.9	18.6	33.3	77	-8	.48	.06	.86	2	4.4
March------	54.2	23.8	39.0	87	-3	1.06	.32	1.53	3	7.1
April------	67.9	36.8	52.4	91	14	1.73	.87	2.27	4	2.6
May--------	77.1	47.7	62.4	98	27	3.03	1.99	4.28	5	.3
June-------	86.4	57.7	72.1	106	39	3.93	2.17	5.60	7	---
July-------	92.4	63.3	77.9	106	48	3.32	1.99	4.01	5	---
August-----	91.7	61.4	76.6	106	44	2.41	1.34	3.14	4	---
September--	83.3	50.8	67.1	103	30	2.09	.54	3.60	4	---
October----	72.4	38.2	55.3	95	18	1.22	.35	1.50	2	1.8
November---	55.7	24.5	40.1	79	-2	.54	.12	1.39	1	4.4
December---	45.0	16.6	30.8	71	-14	.42	.08	.77	1	5.6
Year-----	68.1	37.7	52.9	108	-18	20.69	17.69	24.18	39	31.0

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 27	May 10	May 24
2 years in 10 later than--	Apr. 22	May 5	May 19
5 years in 10 later than--	Apr. 13	Apr. 25	May 9
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 8	Sept. 29	Sept. 19
2 years in 10 earlier than--	Oct. 12	Oct. 4	Sept. 23
5 years in 10 earlier than--	Oct. 22	Oct. 13	Oct. 3

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	172	150	127
8 years in 10	179	157	134
5 years in 10	192	171	147
2 years in 10	205	184	160
1 year in 10	212	191	166

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Bd	Bridgeport silt loam, 0 to 2 percent slopes	20,400	3.6
Be	Bridgeport silt loam, 2 to 5 percent slopes	4,800	0.8
Ca	Caruso silty clay loam, occasionally flooded	1,800	0.3
Cd	Coly silt loam, 7 to 20 percent slopes	102,000	17.9
Ha	Holdrege silt loam, 0 to 1 percent slopes	17,000	3.0
He	Holdrege silt loam, 1 to 3 percent slopes	257,800	45.1
Mc	McCook silt loam, occasionally flooded	19,100	3.3
Mu	Munjor sandy loam, occasionally flooded	1,940	0.3
Ph	Penden-Canlon loams, 6 to 30 percent slopes	24,000	4.2
Ps	Pleasant silty clay loam	286	*
Ub	Uly silt loam, 3 to 7 percent slopes	90,000	15.7
Uc	Uly silt loam, 4 to 9 percent slopes, eroded	33,000	5.8
	Total	572,126	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability		Winter wheat		Grain sorghum		Corn		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
Bd----------------- Bridgeport	IIc	I	40	55	55	115	---	125	3.0	6.5
Be----------------- Bridgeport	IIIe	IIIe	36	55	47	110	---	115	---	5.5
Ca----------------- Caruso	IIw	IIw	30	40	50	110	---	120	3.0	6.0
Cd----------------- Coly	VIe	---	---	---	---	---	---	---	---	---
Ha----------------- Holdrege	IIc	I	40	55	60	125	---	135	2.5	6.0
He----------------- Holdrege	IIe	IIe	38	50	55	120	---	130	2.3	5.5
Mc----------------- McCook	IIw	IIw	35	---	60	115	---	130	2.8	6.0
Mu----------------- Munjor	IIIw	IIIw	28	---	50	---	---	---	2.0	3.0
Ph----------------- Penden-Canlon	VIe	---	---	---	---	---	---	---	---	---
Ps----------------- Pleasant	IVw	---	25	---	32	---	---	---	---	---
Ub----------------- Uly	IIIe	IIIe	35	---	40	90	---	---	1.9	4.5
Uc----------------- Uly	IVe	IVe	28	---	25	---	---	---	1.7	3.5

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Bd, Be----------- Bridgeport	Loamy Terrace-----------	Favorable	4,000	Big bluestem-----------	40
		Normal	3,000	Sideoats grama-----------	25
		Unfavorable	2,000	Western wheatgrass-----------	15
				Little bluestem-----------	15
Ca----------- Caruso	Subirrigated-----------	Favorable	7,500	Big bluestem-----------	30
		Normal	6,500	Switchgrass-----------	15
		Unfavorable	5,000	Prairie cordgrass-----------	10
				Indiangrass-----------	10
				Little bluestem-----------	10
				Western wheatgrass-----------	5
				Sedge-----------	5
Cd----------- Coly	Limy Upland-----------	Favorable	3,500	Little bluestem-----------	30
		Normal	2,500	Big bluestem-----------	20
		Unfavorable	2,000	Sideoats grama-----------	15
				Western wheatgrass-----------	5
				Blue grama-----------	5
				Switchgrass-----------	5
Ha, He----------- Holdrege	Loamy Upland-----------	Favorable	3,000	Big bluestem-----------	20
		Normal	2,000	Little bluestem-----------	20
		Unfavorable	1,500	Sideoats grama-----------	20
				Blue grama-----------	10
				Western wheatgrass-----------	10
				Buffalograss-----------	5
				Sand dropseed-----------	5
				Sedge-----------	5
Mc----------- McCook	Loamy Lowland-----------	Favorable	5,000	Big bluestem-----------	45
		Normal	4,000	Switchgrass-----------	10
		Unfavorable	3,000	Indiangrass-----------	10
				Sideoats grama-----------	10
				Little bluestem-----------	5
				Western wheatgrass-----------	5
Mu----------- Munjor	Sandy Lowland-----------	Favorable	3,500	Sand bluestem-----------	35
		Normal	3,000	Switchgrass-----------	15
		Unfavorable	2,500	Little bluestem-----------	15
				Indiangrass-----------	10
				Western wheatgrass-----------	5
				Chickasaw plum-----------	5
Ph*: Penden-----------	Limy Upland-----------	Favorable	3,000	Little bluestem-----------	30
		Normal	2,500	Big bluestem-----------	25
		Unfavorable	1,500	Sideoats grama-----------	10
				Switchgrass-----------	5
				Western wheatgrass-----------	5
				Blue grama-----------	5
Canlon-----------	Shallow Limy-----------	Favorable	2,400	Little bluestem-----------	25
		Normal	1,600	Sideoats grama-----------	20
		Unfavorable	900	Big bluestem-----------	20
				Switchgrass-----------	5
				Hairy grama-----------	5
				Blue grama-----------	5
Ps----------- Pleasant	Clay Upland-----------	Favorable	2,400	Western wheatgrass-----------	50
		Normal	1,800	Buffalograss-----------	15
		Unfavorable	1,000	Blue grama-----------	10
				Sedge-----------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
Ub, Uc----------- Uly	Loamy Upland------------------	Favorable	3,500	Big bluestem------------------	20
		Normal	2,500	Little bluestem---------------	15
		Unfavorable	1,500	Sideoats grama----------------	10
				Blue grama--------------------	10
				Western wheatgrass------------	10
				Buffalograss------------------	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Bd, Be-----------Bridgeport	Lilac, American plum.	Amur honeysuckle	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, hackberry, green ash, Russian-olive.	Honeylocust, Siberian elm.	Eastern cottonwood.
Ca---------------Caruso	American plum, lilac.	Amur honeysuckle	Russian-olive, eastern redcedar, Rocky Mountain juniper, green ash, ponderosa pine, hackberry.	Honeylocust-------	Siberian elm, eastern cottonwood.
Cd---------------Coly	Siberian peashrub, fragrant sumac, silver buffaloberry.	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, green ash, Russian-olive.	Honeylocust, Siberian elm.	---	---
Ha, He-----------Holdrege	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm------	---
Mc---------------McCook	American plum, lilac.	Amur honeysuckle	Eastern redcedar, ponderosa pine, Russian-olive, hackberry, green ash, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Mu---------------Munjor	American plum-----	Amur honeysuckle, lilac.	Eastern redcedar, ponderosa pine, green ash, Russian mulberry, Austrian pine, Russian-olive.	Honeylocust, hackberry.	Eastern cottonwood.
Ph:					
Penden-----------	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, green ash, black locust, Russian-olive.	Honeylocust, Siberian elm.	---	---
Canlon.					
Ps. Pleasant					
Ub, Uc-----------Uly	Amur honeysuckle, lilac.	Common chokecherry, Russian mulberry.	Eastern redcedar, green ash, Russian-olive, honeylocust, Austrian pine, hackberry, bur oak.	Siberian elm------	---

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Bd: Bridgeport	Severe: flooding.	Slight	Slight	Slight.
Be: Bridgeport	Slight	Slight	Moderate: slope.	Slight.
Ca: Caruso	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.
Cd: Coly	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Ha: Holdrege	Slight	Slight	Slight	Slight.
He: Holdrege	Slight	Slight	Moderate: slope.	Slight.
Mc: McCook	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Mu: Munjor	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ph*:				
Penden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Canlon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, small stones.	Moderate: slope.
Ps: Pleasant	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ub: Uly	Slight	Slight	Moderate: slope.	Slight.
Uc: Uly	Slight	Slight	Severe: slope.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor")

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
Bd----------------- Bridgeport	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Be----------------- Bridgeport	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Ca----------------- Caruso	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair.
Cd----------------- Coly	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ha, He------------- Holdrege	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.
Mc----------------- McCook	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Mu----------------- Munjor	Fair	Fair	Good	Good	Poor	Poor	Fair	Poor	Good.
Ph*:									
Penden------------	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
Canlon------------	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Ps----------------- Pleasant	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Ub, Uc------------- Uly	Fair	Good	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Bd: Bridgeport	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Be: Bridgeport	Slight	Slight	Slight	Slight	Severe: low strength.
Ca: Caruso	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding.
Cd: Coly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
Ha, He: Holdrege	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Mc: McCook	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Mu: Munjor	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Ph*:					
Penden	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Canlon	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
Ps: Pleasant	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
Ub, Uc: Uly	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Bd: Bridgeport	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Be: Bridgeport	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Ca: Caruso	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
Cd: Coly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Ha: Holdrege	Slight	Moderate: seepage.	Slight	Slight	Good.
He: Holdrege	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Mc: McCook	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Mu: Munjor	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: thin layer.
Ph*:					
Penden	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Canlon	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Ps: Pleasant	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Ub: Uly	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Uc: Uly	Slight	Severe: slope.	Slight	Slight	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Bd, Be: Bridgeport	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ca: Caruso	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Cd: Coly	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Ha, He: Holdrege	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Mc: McCook	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Mu: Munjor	Good	Probable	Improbable: too sandy.	Good.
Ph*:				
Penden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Canlon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Ps: Pleasant	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Ub, Uc: Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "moderate" and "severe." The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Bd: Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Be: Bridgeport	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Ca: Caruso	Moderate: seepage.	Severe: piping.	Flooding	Wetness, flooding.	Wetness	Favorable.
Cd: Coly	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ha, He: Holdrege	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Mc: McCook	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
Mu: Munjor	Severe: seepage.	Severe: piping.	Deep to water	Flooding	Soil blowing	Favorable.
Ph*:						
Penden	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Canlon	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Ps: Pleasant	Moderate: seepage.	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Ub, Uc: Uly	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Bd, Be---------- Bridgeport	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	20-35	4-19
	12-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	90-100	65-100	25-40	8-20
Ca--------------- Caruso	0-18	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	70-95	35-45	11-20
	18-60	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	65-85	25-45	5-20
Cd--------------- Coly	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
	5-60	Silt loam, loam	ML, CL, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
Ha, He---------- Holdrege	0-10	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-40	2-18
	10-24	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	90-100	30-50	15-35
	24-60	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	95-100	95-100	25-40	9-17
Mc--------------- McCook	0-14	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	14-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<20	NP-10
Mu--------------- Munjor	0-15	Sandy loam-------	SM, ML, CL-ML, SM-SC	A-2-4, A-4	0	100	95-100	65-100	25-55	15-30	NP-7
	15-60	Fine sandy loam, loamy sand, sandy loam.	SM, SC, ML, CL	A-4	0	100	65-100	35-100	35-65	15-30	3-10
Ph*:											
Penden----------	0-16	Loam-------------	CL	A-4, A-6	0	100	100	85-100	65-95	25-40	7-20
	16-25	Clay loam, loam, silty clay loam.	CL	A-6, A-7-6	0	100	100	85-100	60-90	30-45	11-25
	25-60	Clay loam, loam	CL	A-6, A-7-6	0	100	100	75-100	55-75	30-45	11-25
Canlon----------	0-4	Loam-------------	CL, CL-ML	A-4, A-6	0	90-100	75-100	65-100	50-90	20-40	4-20
	4-14	Loam, gravelly loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	75-100	55-100	50-95	35-85	20-40	4-20
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ps--------------- Pleasant	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-25
	11-44	Silty clay loam, silty clay, clay.	CH, CL	A-7	0	100	100	95-100	95-100	40-65	20-45
	44-60	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	95-100	80-100	25-40	NP-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ub---------------- Uly	0-11	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	11-19	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	19-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
Uc---------------- Uly	0-7	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	7-15	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	15-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Bd, Be-----------	0-12	14-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low-------	0.32	5	6	1-4
Bridgeport	12-60	18-30	1.35-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.43			
Ca---------------	0-18	27-35	1.35-1.45	0.2-0.6	0.17-0.23	7.4-8.4	<4	Moderate	0.28	5	4L	1-4
Caruso	18-60	18-35	1.35-1.50	0.6-2.0	0.16-0.22	7.4-8.4	<4	Low-------	0.28			
Cd---------------	0-5	18-24	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.43	5	4L	1-2
Coly	5-60	18-24	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.43			
Ha, He-----------	0-10	15-25	1.40-1.60	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	0.32	5	6	1-3
Holdrege	10-24	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.43			
	24-60	18-30	1.30-1.50	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
Mc---------------	0-14	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.32	5	4L	2-4
McCook	14-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-------	0.43			
Mu---------------	0-15	7-15	1.30-1.40	2.0-6.0	0.14-0.20	7.4-8.4	<2	Low-------	0.24	5	3	.5-1
Munjor	15-60	7-15	1.30-1.40	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.24			
Ph*:												
Penden----------	0-16	20-27	1.30-1.45	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low-------	0.28	5	4L	1-4
	16-25	24-35	1.35-1.50	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.37			
	25-60	24-35	1.30-1.50	0.6-2.0	0.14-0.19	7.9-8.4	<2	Moderate	0.37			
Canlon----------	0-4	12-27	1.30-1.45	0.6-2.0	0.15-0.24	7.4-8.4	<2	Low-------	0.32	2	4L	---
	4-14	8-27	1.35-1.50	0.6-2.0	0.15-0.22	7.4-8.4	<2	Low-------	0.32			
	14	---	---	---	---	---	---	-----------	----			
Ps---------------	0-11	27-40	1.10-1.30	0.2-0.6	0.19-0.21	6.6-7.3	<2	Moderate	0.24	3	7	2-5
Pleasant	11-44	35-45	1.10-1.30	<0.06	0.14-0.18	6.6-7.8	<2	High------	0.24			
	44-60	20-32	1.10-1.30	0.6-2.0	0.18-0.20	7.4-8.4	<2	Low-------	0.24			
Ub---------------	0-11	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-3
Uly	11-19	20-30	1.20-1.30	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
	19-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
Uc---------------	0-7	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-2
Uly	7-15	20-30	1.20-1.30	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
	15-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Bd----------------- Bridgeport	B	Rare----------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Be----------------- Bridgeport	B	None----------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Ca----------------- Caruso	C	Occasional	Very brief	Apr-Sep	2.0-3.0	Apparent	Mar-Jun	>60	---	Moderate	High------	Moderate.
Cd----------------- Coly	B	None----------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Ha, He------------- Holdrege	B	None----------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Mc----------------- McCook	B	Occasional	Very brief	Apr-Jul	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Mu----------------- Munjor	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Ph*:												
Penden------------	B	None----------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Canlon------------	D	None----------	---	---	>6.0	---	---	10-20	Hard	Low-------	Low-------	Low.
Ps----------------- Pleasant	D	None----------	---	---	+2-0	Perched	Apr-Sep	>60	---	Low-------	High------	Low.
Ub, Uc------------- Uly	B	None----------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

(LL means liquid limit; PI, plasticity index; MD, maximum dry density; and OM, optimum moisture)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							LL	PI	Moisture density	
			Percentage passing sieve--				Percentage smaller than--					MD	OM
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
										Pct		Lb/ft3	Pct
Bridgeport silt loam: (S83KS-039-002)													
Ap---- 0 to 5	A-6	CL	100	100	99	91	32	6	2	35	13	99	18
C----- 14 to 60	A-4	CL	100	100	97	77	25	12	10	27	7	110	15
Coly silt loam: (S83KS-039-001)													
A----- 0 to 5	A-7	ML	100	100	96	90	12	2	0	41	13	94	22
C----- 9 to 60	A-4	ML	100	100	100	94	32	6	2	34	10	101	20

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bridgeport	Fine-silty, mixed, mesic Fluventic Haplustolls
Canlon	Loamy, mixed (calcareous), mesic Lithic Ustorthents
Caruso	Fine-loamy, mixed, mesic Fluvaquentic Haplustolls
Coly	Fine-silty, mixed (calcareous), mesic Typic Ustorthents
Holdrege	Fine-silty, mixed, mesic Typic Argiustolls
McCook	Coarse-silty, mixed, mesic Fluventic Haplustolls
Munjor	Coarse-loamy, mixed (calcareous), mesic Typic Ustifluvents
Penden	Fine-loamy, mixed, mesic Typic Calciustolls
Pleasant	Fine, montmorillonitic, mesic Torrertic Argiustolls
Uly	Fine-silty, mixed, mesic Typic Haplustolls

INTERPRETIVE GROUPS

Map symbol	Map unit	Land capability*		Prime farmland*	Range site
		N	I		
Bd	Bridgeport silt loam, 0 to 2 percent slopes	IIc	I	Yes	Loamy Terrace.
Be	Bridgeport silt loam, 2 to 5 percent slopes	IIIe	IIIe	Yes	Loamy Terrace.
Ca	Caruso silt loam, occasionally flooded	IIw	IIw	Yes	Subirrigated.
Cd	Coly silt loam, 7 to 20 percent slopes	VIe	---	No	Limy Upland.
Ha	Holdrege silt loam, 0 to 1 percent slopes	IIc	I	Yes	Loamy Upland.
He	Holdrege silt loam, 1 to 3 percent slopes	IIe	IIe	Yes	Loamy Upland.
Mc	McCook silt loam, occasionally flooded	IIw	IIw	Yes	Loamy Lowland.
Mu	Munjor sandy loam, occasionally flooded	IIIw	IIIw	Yes	Sandy Lowland.
Ph	Penden-Canlon loams, 6 to 30 percent slopes	VIe	---	No	
	Penden				Limy Upland.
	Canlon				Shallow Limy.
Ps	Pleasant silty clay loam	IVw	---	No	Clay Upland.
Ub	Uly silt loam, 3 to 7 percent slopes	IIIe	IIIe	Yes	Loamy Upland.
Uc	Uly silt loam, 4 to 9 percent slopes, eroded	IVe	IVe	No	Loamy Upland.

* A soil complex is treated as a single management unit in the land capability and prime farmland columns. The N column is for nonirrigated soils; the I column is for irrigated soils.

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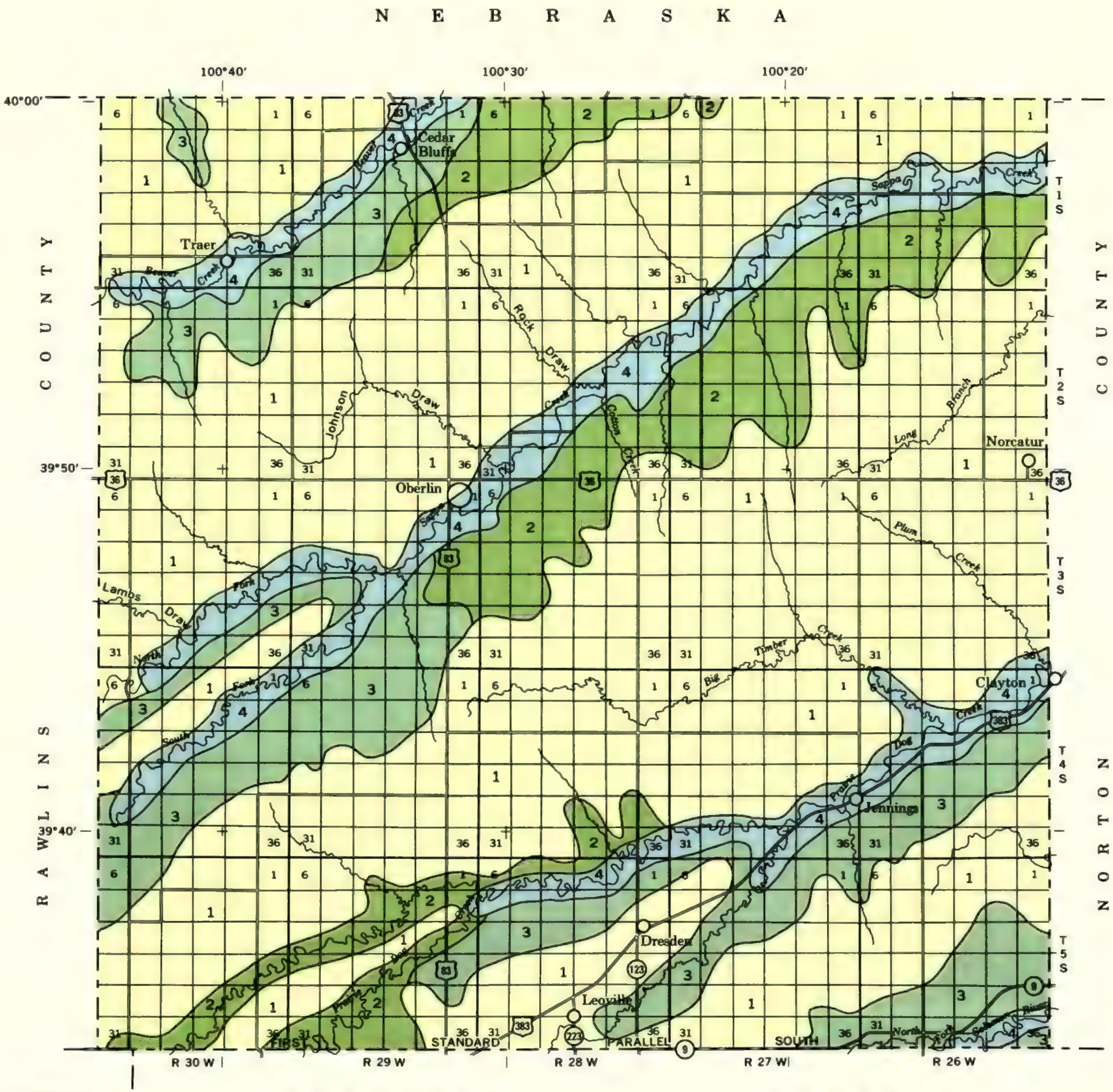


Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND

1	Holdrege-Uly association: Deep, nearly level to moderately sloping, well drained soils that have a silty subsoil; on uplands
2	Coly-Uly-Holdrege association: Deep, gently sloping to moderately steep, well drained soils that have a silty subsoil; on uplands
3	Uly-Coly-Penden association: Deep, moderately sloping to moderately steep, well drained soils that have a silty or loamy subsoil; on uplands
4	Bridgeport-McCook association: Deep, nearly level and gently sloping, well drained soils that have a silty subsoil; on stream terraces, flood plains, and alluvial fans

COMPILED 1986

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

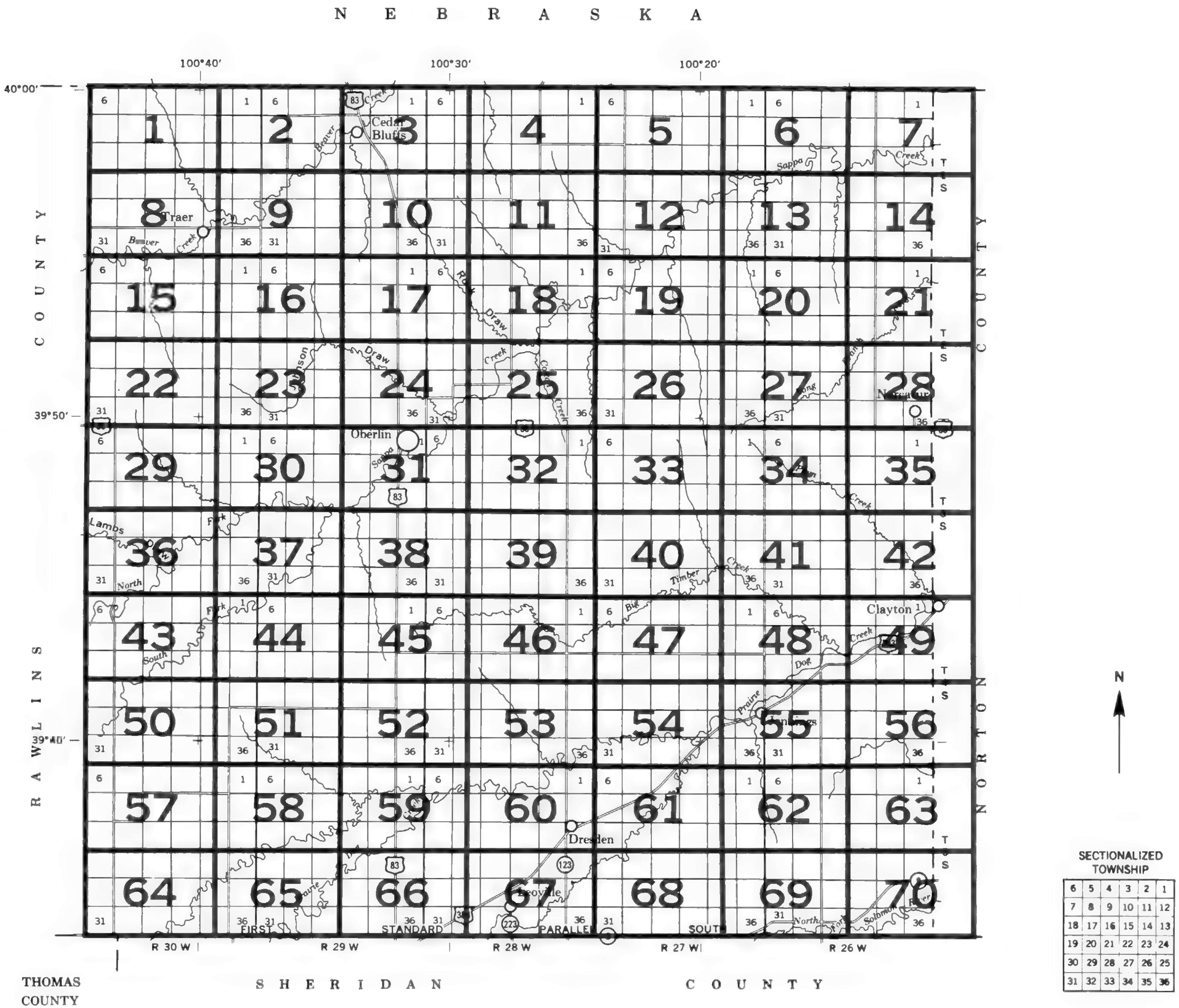
GENERAL SOIL MAP

DECATUR COUNTY, KANSAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



INDEX TO MAP SHEETS
DECATUR COUNTY, KANSAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

SYMBOL	NAME
Bd	Bridgeport silt loam, 0 to 2 percent slopes
Be	Bridgeport silt loam, 2 to 5 percent slopes
Ca	Caruso silty clay loam, occasionally flooded
Cd	Coly silt loam, 7 to 20 percent slopes
Ha	Holdrege silt loam, 0 to 1 percent slopes
He	Holdrege silt loam, 1 to 3 percent slopes
Mc	McCook silt loam, occasionally flooded
Mu	Munjor sandy loam, occasionally flooded
Ph	Penden-Canlon loams, 6 to 30 percent slopes
Ps	Pleasant silty clay loam
Ub	Uly silt loam, 3 to 7 percent slopes
Uc	Uly silt loam, 4 to 9 percent slopes, eroded

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

MISCELLANEOUS

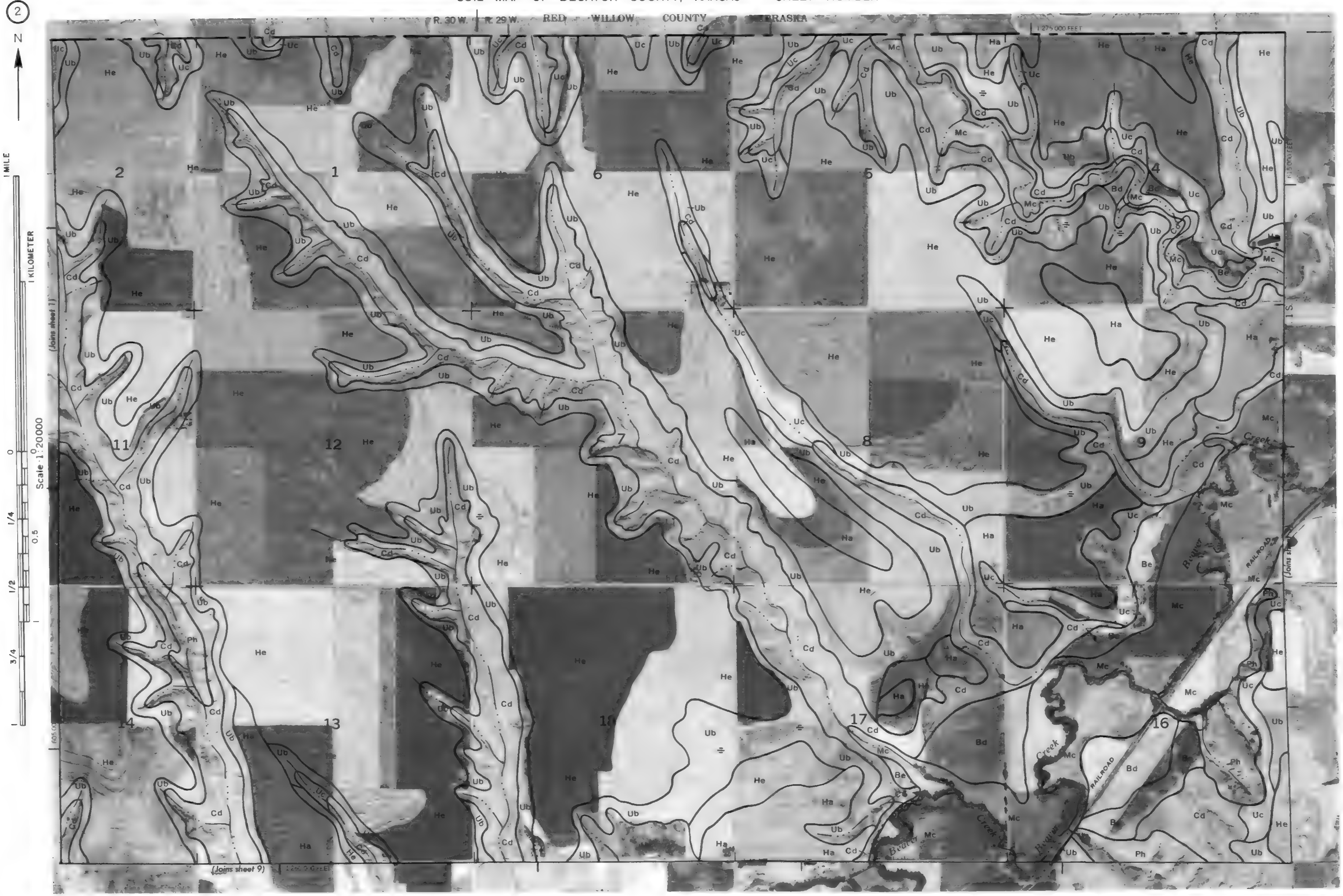
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Borrow area

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 1

DECATUR COUNTY, KANSAS NO. 1

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 2



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DECATUR COUNTY, KANSAS NO. 2

DECATUR COUNTY, KANSAS NO. 3

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 4

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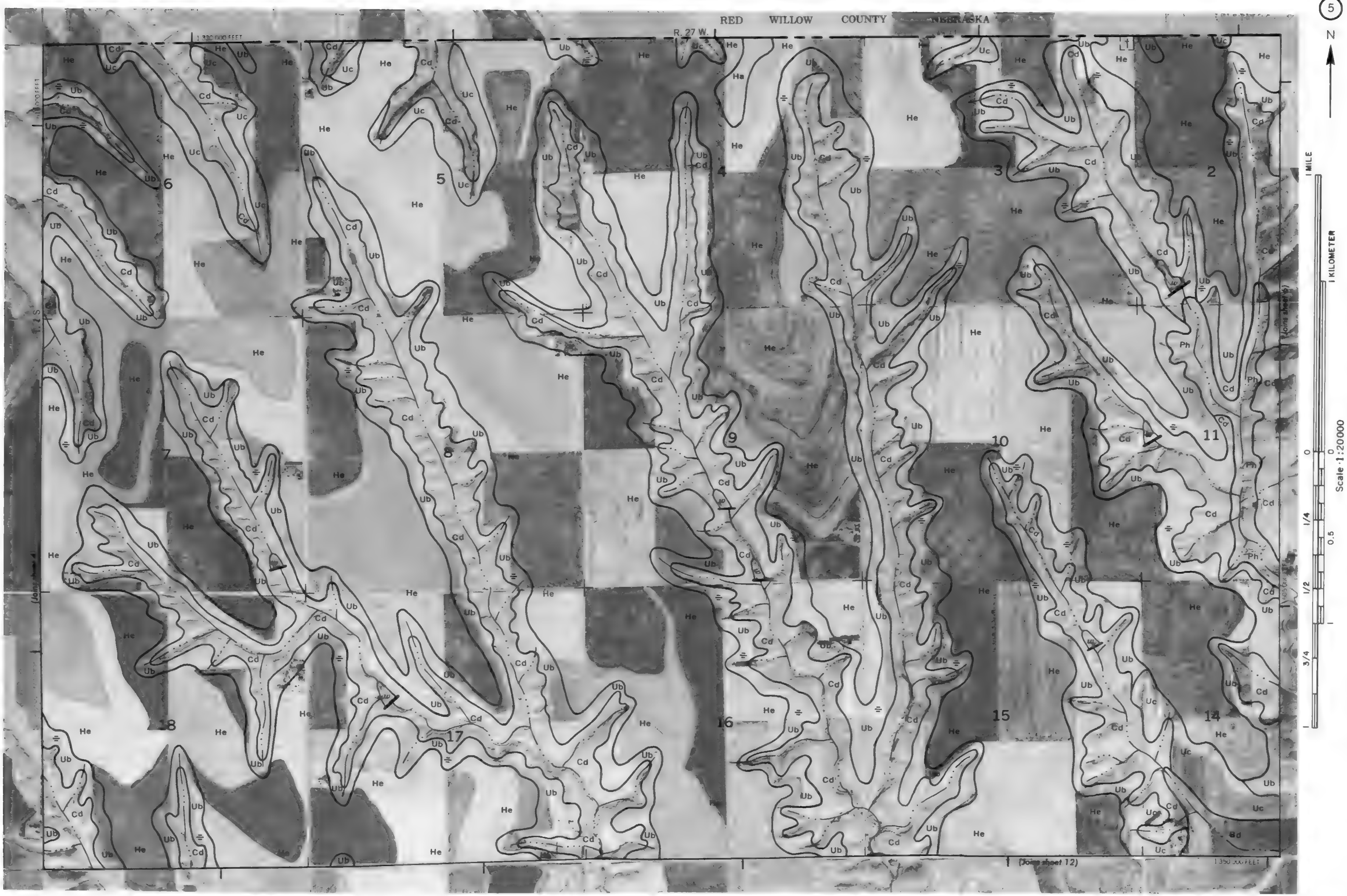
DECATUR COUNTY, KANSAS NO. 4

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 5



DECATUR COUNTY, KANSAS NO. 5

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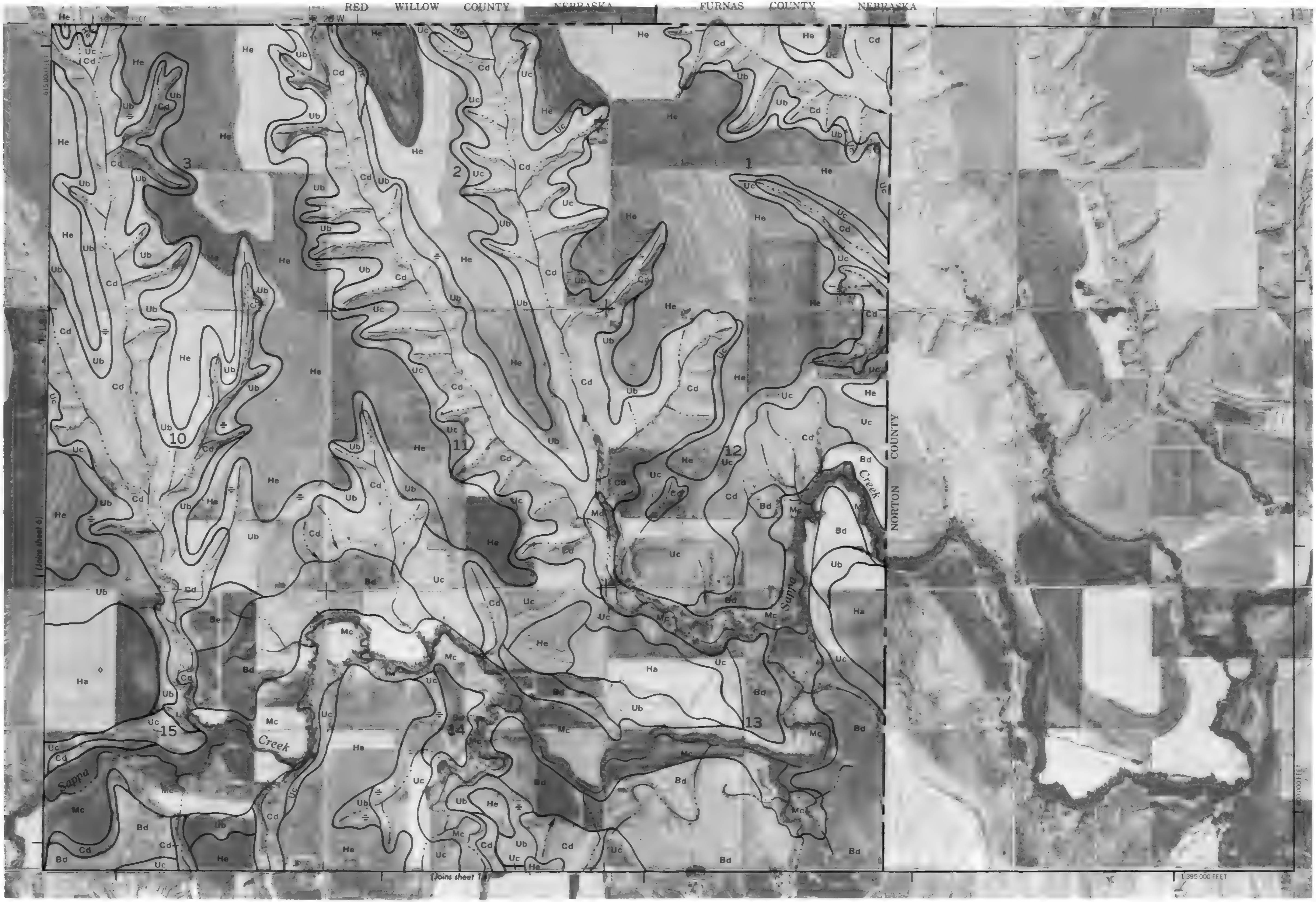
SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 6

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

DECATUR COUNTY, KANSAS NO. 6

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 7



7

N

1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4

0 0.5

DECATUR COUNTY, KANSAS NO. 7

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners if shown are approximately positioned

DECATUR COUNTY, KANSAS NO. 8

DECATUR COUNTY, KANSAS NO. 9

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 10

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 10

(11)

DECATUR COUNTY, KANSAS NO. 11

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners if shown are approximately positioned

N

1 MILE

1 KILOMETER

Scale 1:20000

(12)

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

DECATUR COUNTY, KANSAS NO. 12

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners if shown are approximately positioned.

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 15

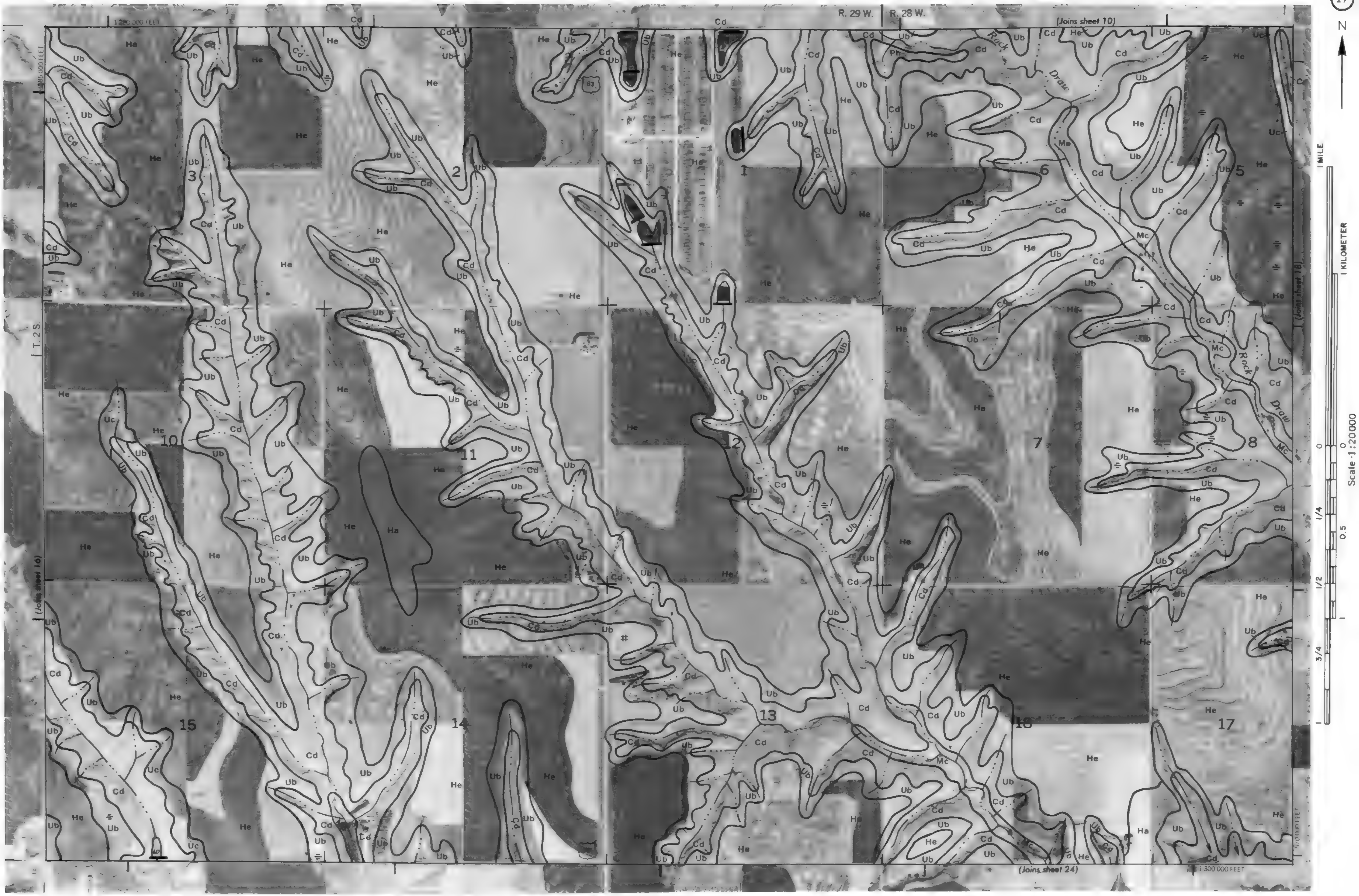
DECATUR COUNTY, KANSAS NO. 15

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

16

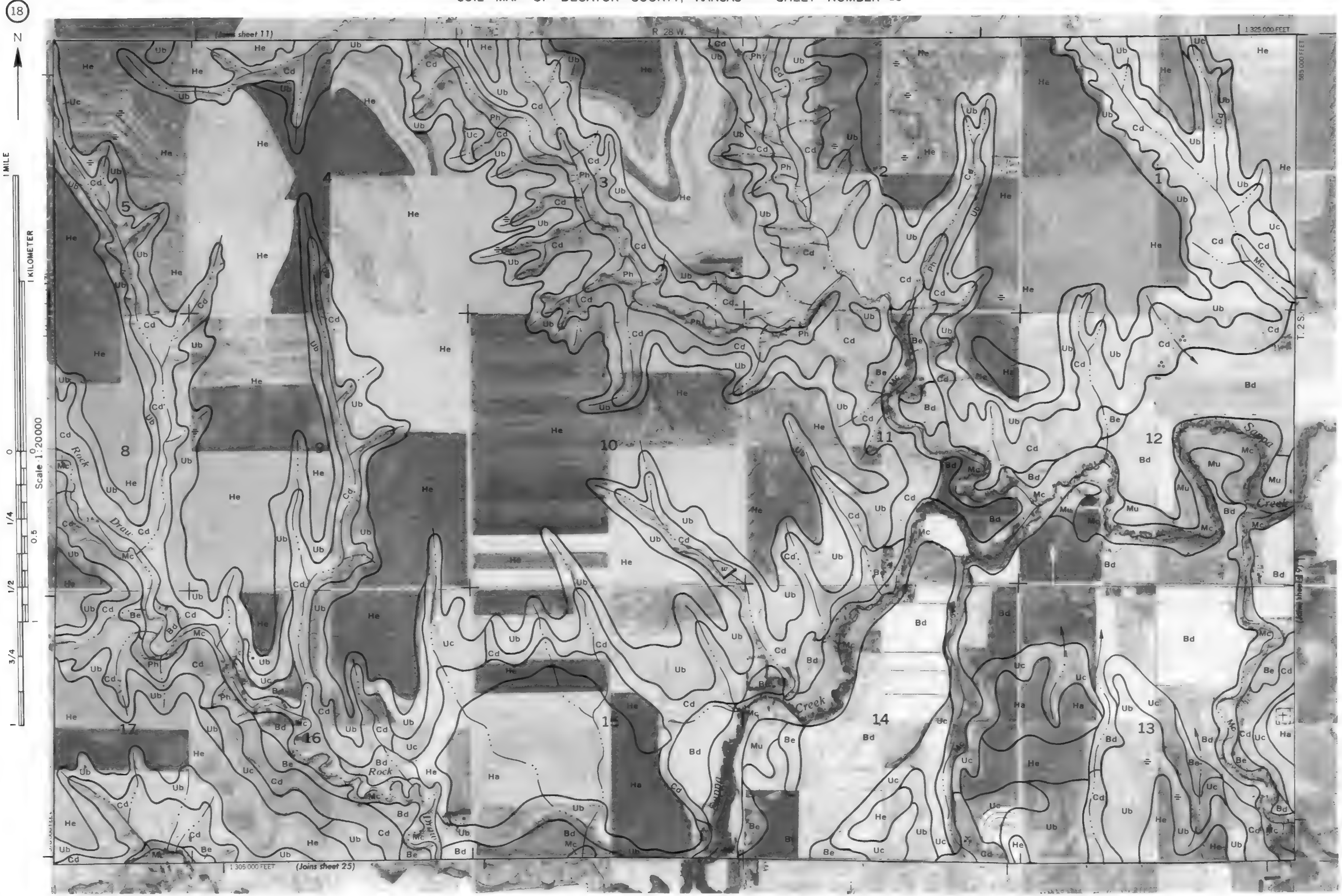
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 16



DECATUR COUNTY, KANSAS NO. 17

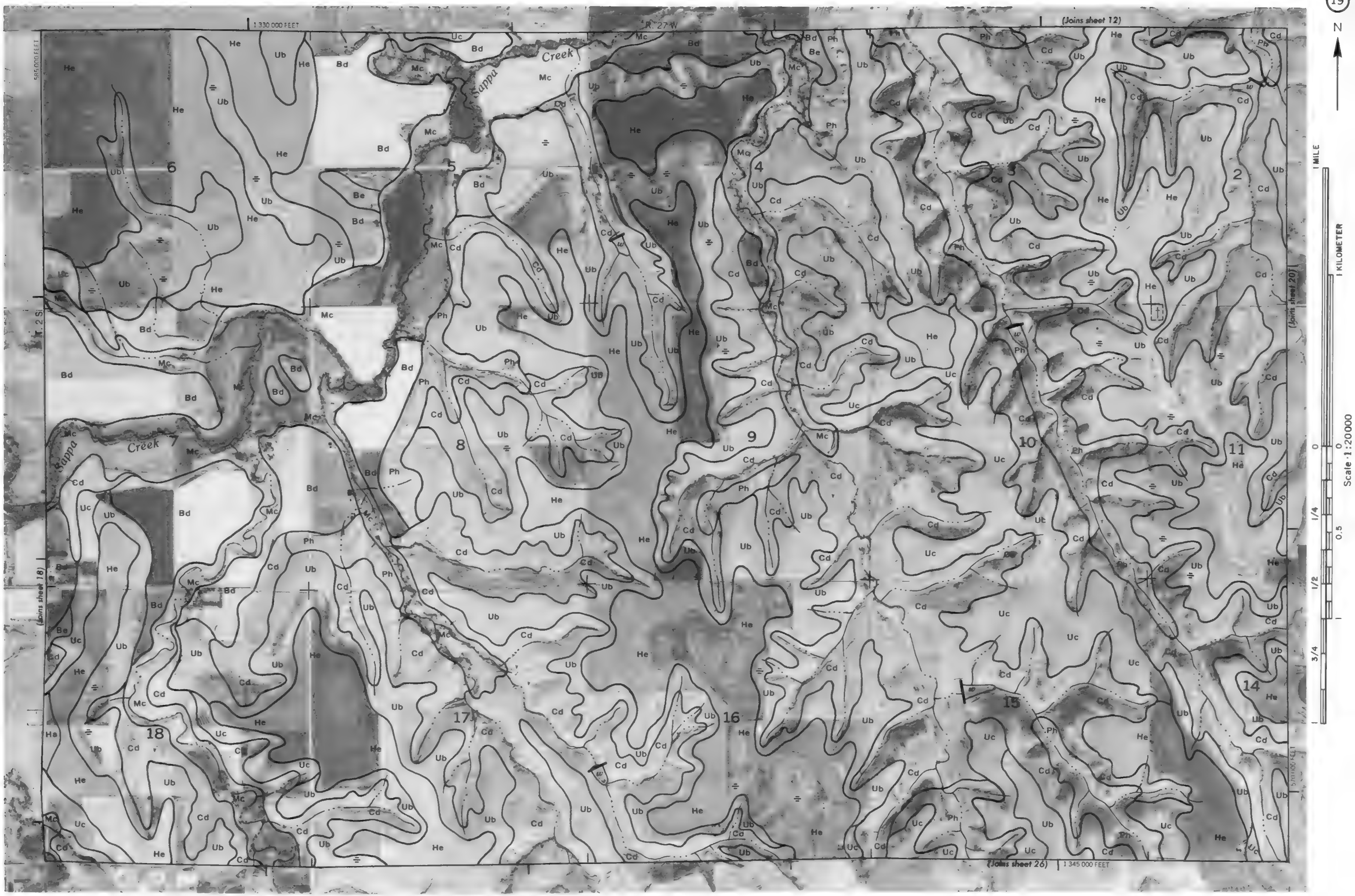
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

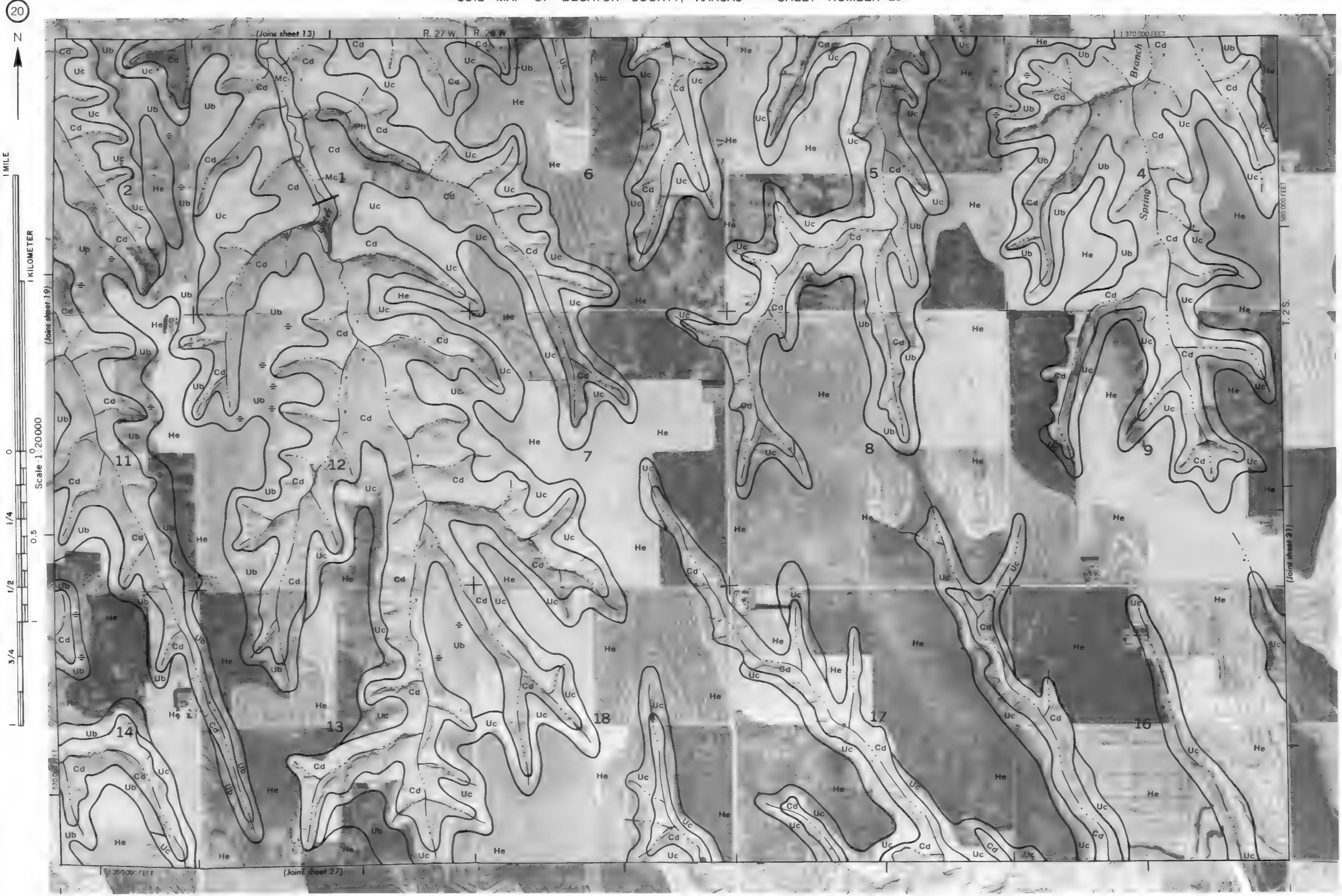
DECATUR COUNTY, KANSAS NO. 18

19



DECATUR COUNTY, KANSAS NO. 19

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

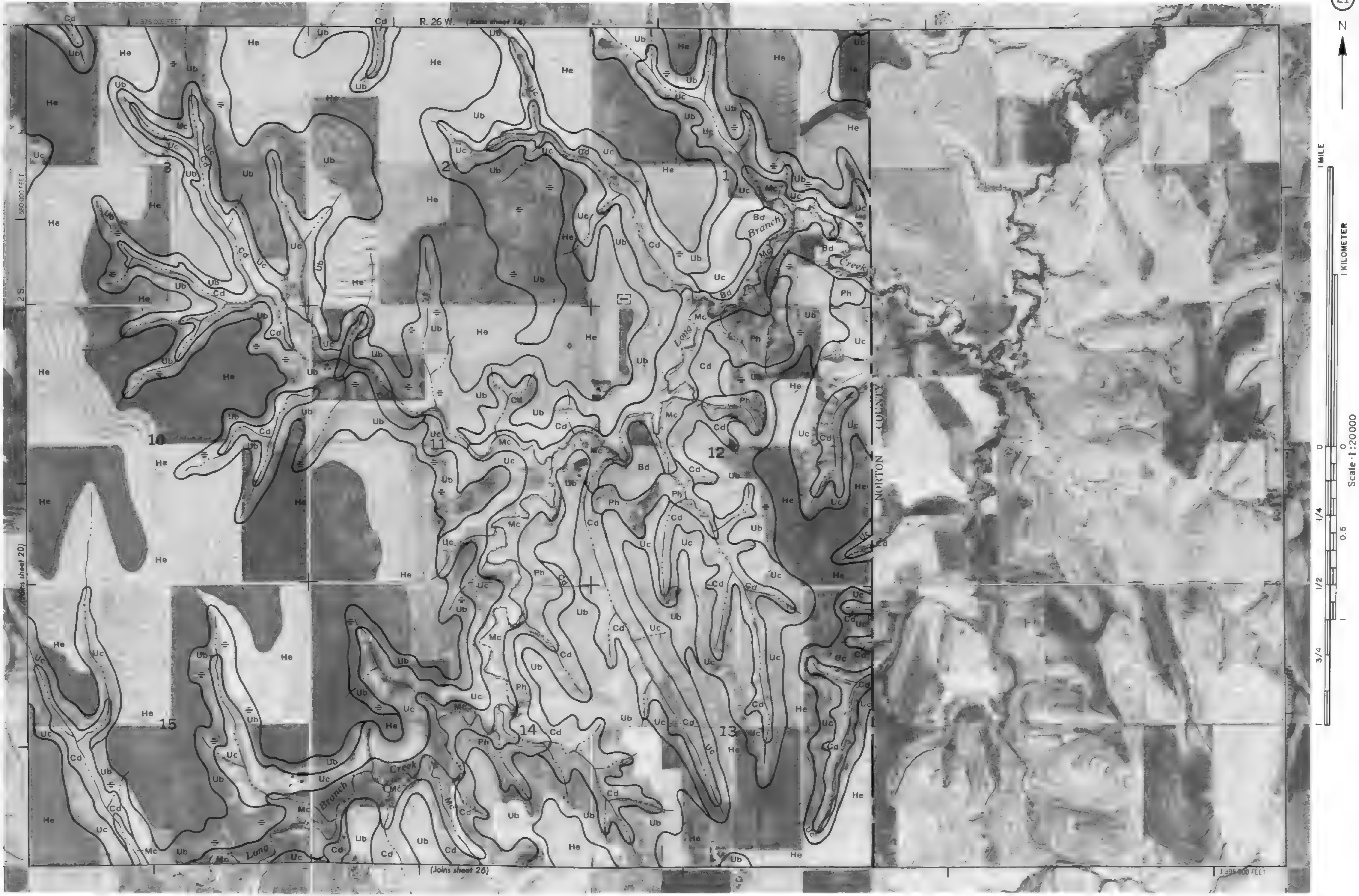


This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

DECATUR COUNTY, KANSAS NO. 20

DECATUR COUNTY, KANSAS NO. 21

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 22

N

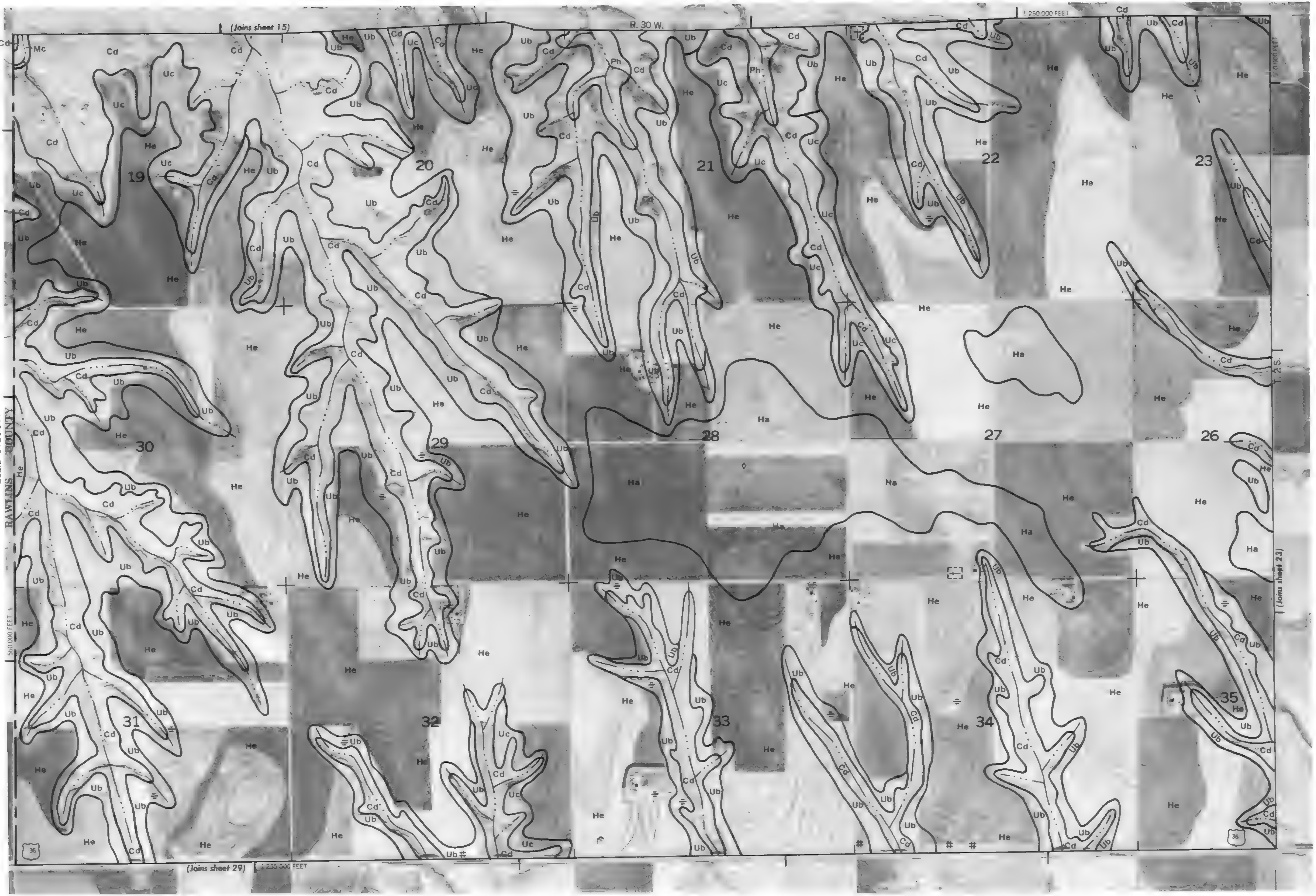
1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

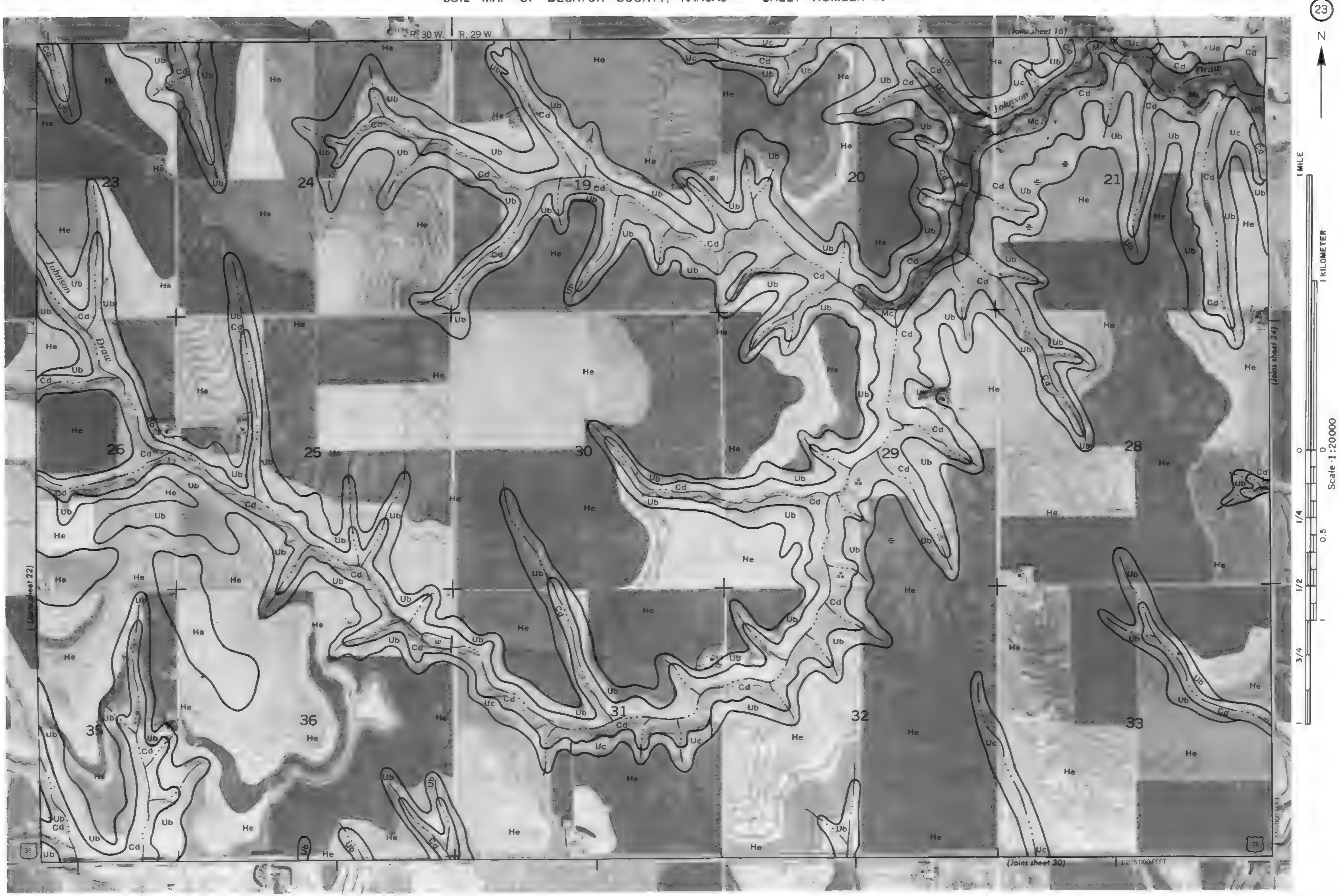
0 0.5 1

Scale 1:20000



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners if shown are approximately positioned.

DECATUR COUNTY, KANSAS NO. 22



DECATUR COUNTY, KANSAS NO. 23

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners if shown are approximately positioned.

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 24

DECATUR COUNTY, KANSAS NO. 25

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 26

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 26

DECATUR COUNTY, KANSAS NO. 27

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

28

N

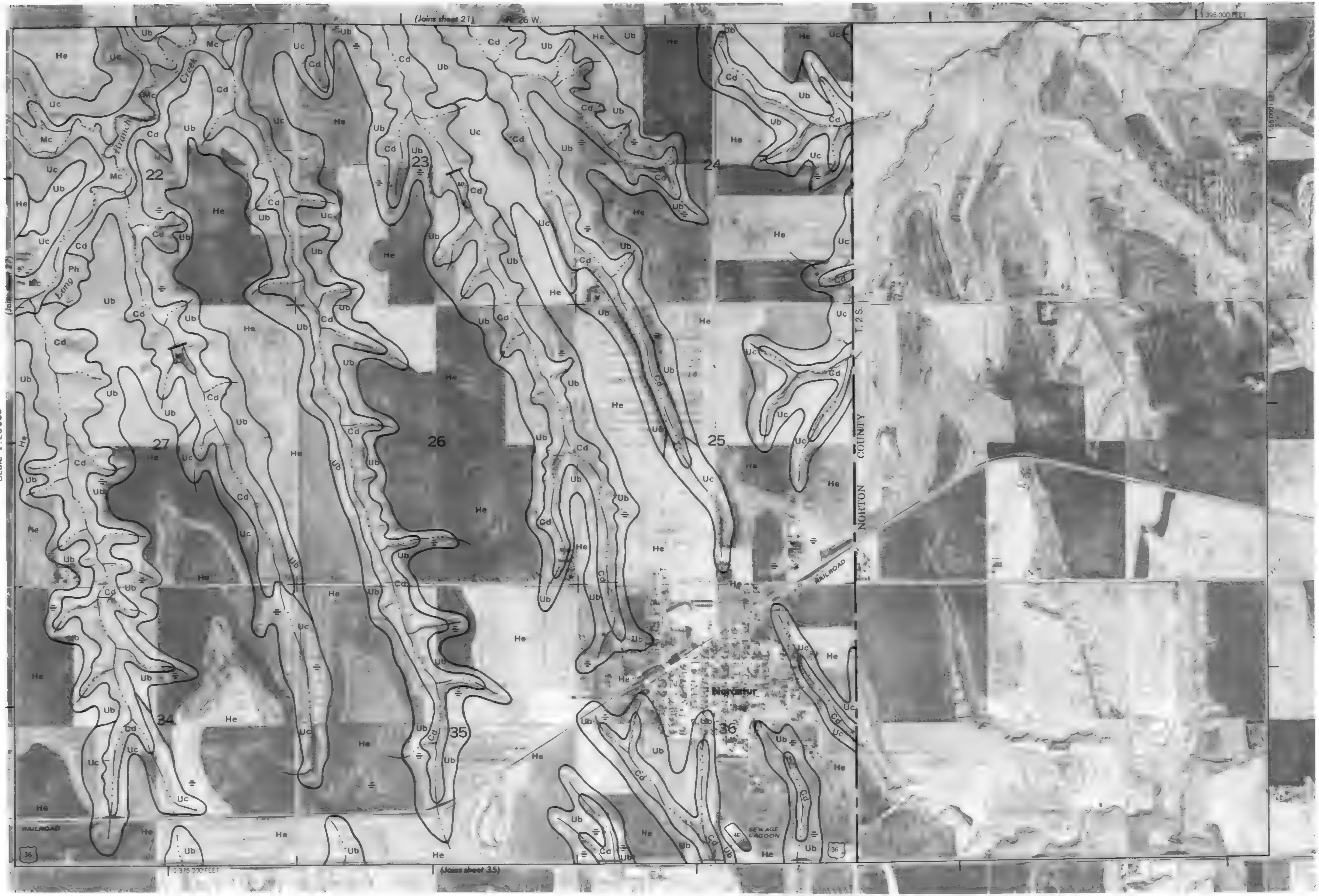
1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

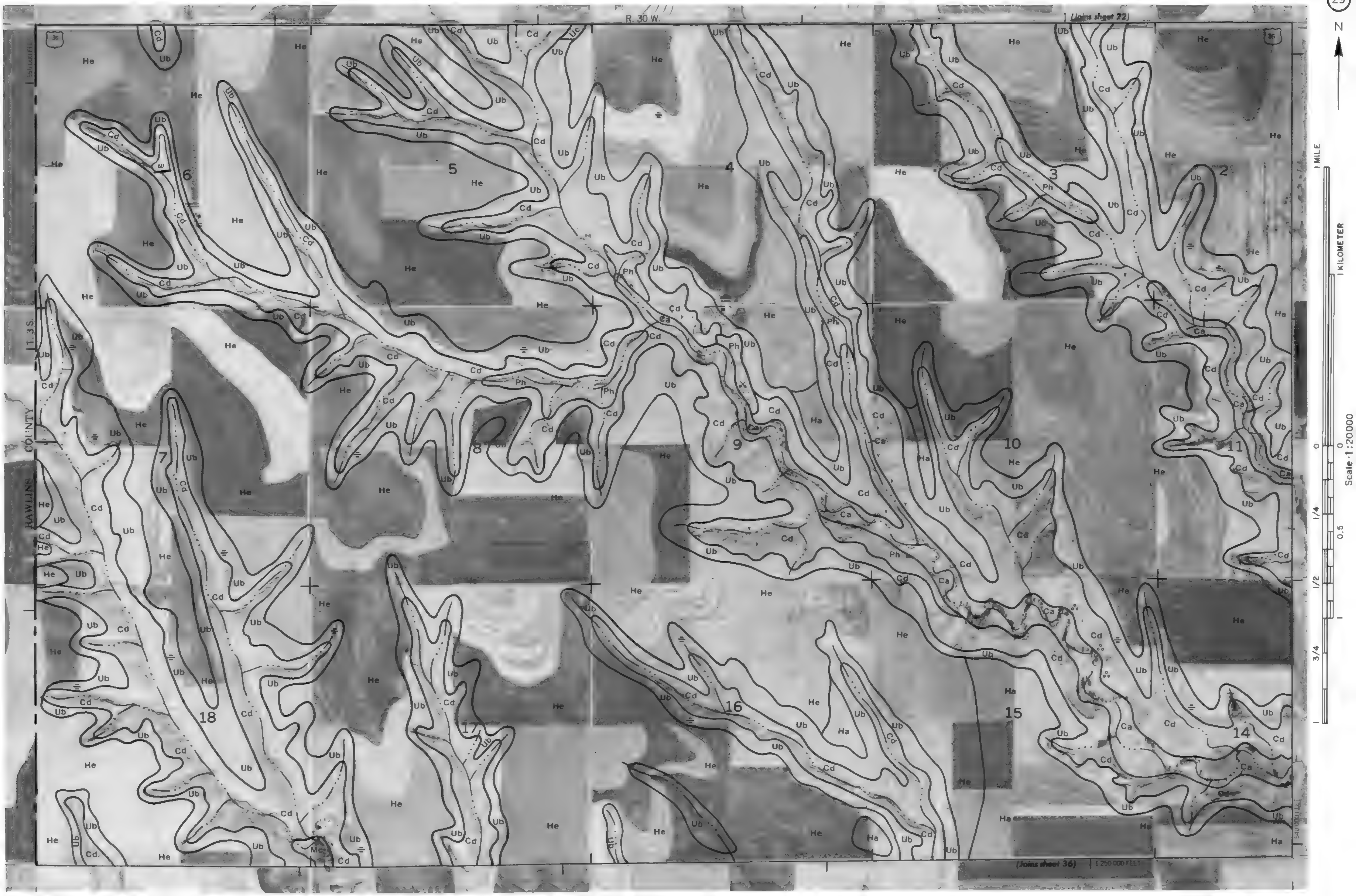
0 0.5 1



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

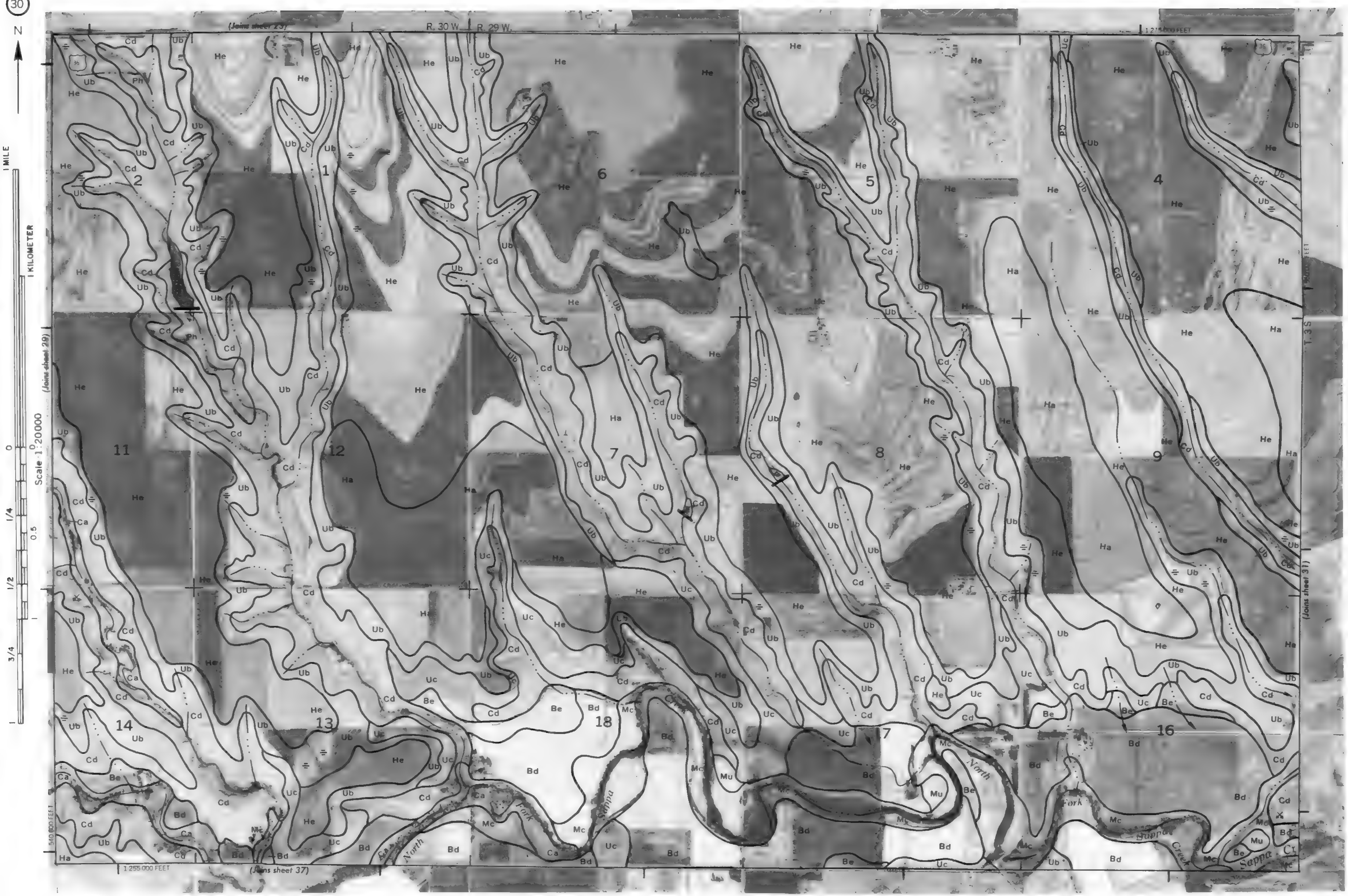
DECATUR COUNTY, KANSAS NO. 28

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 29



DECATUR COUNTY, KANSAS NO. 29

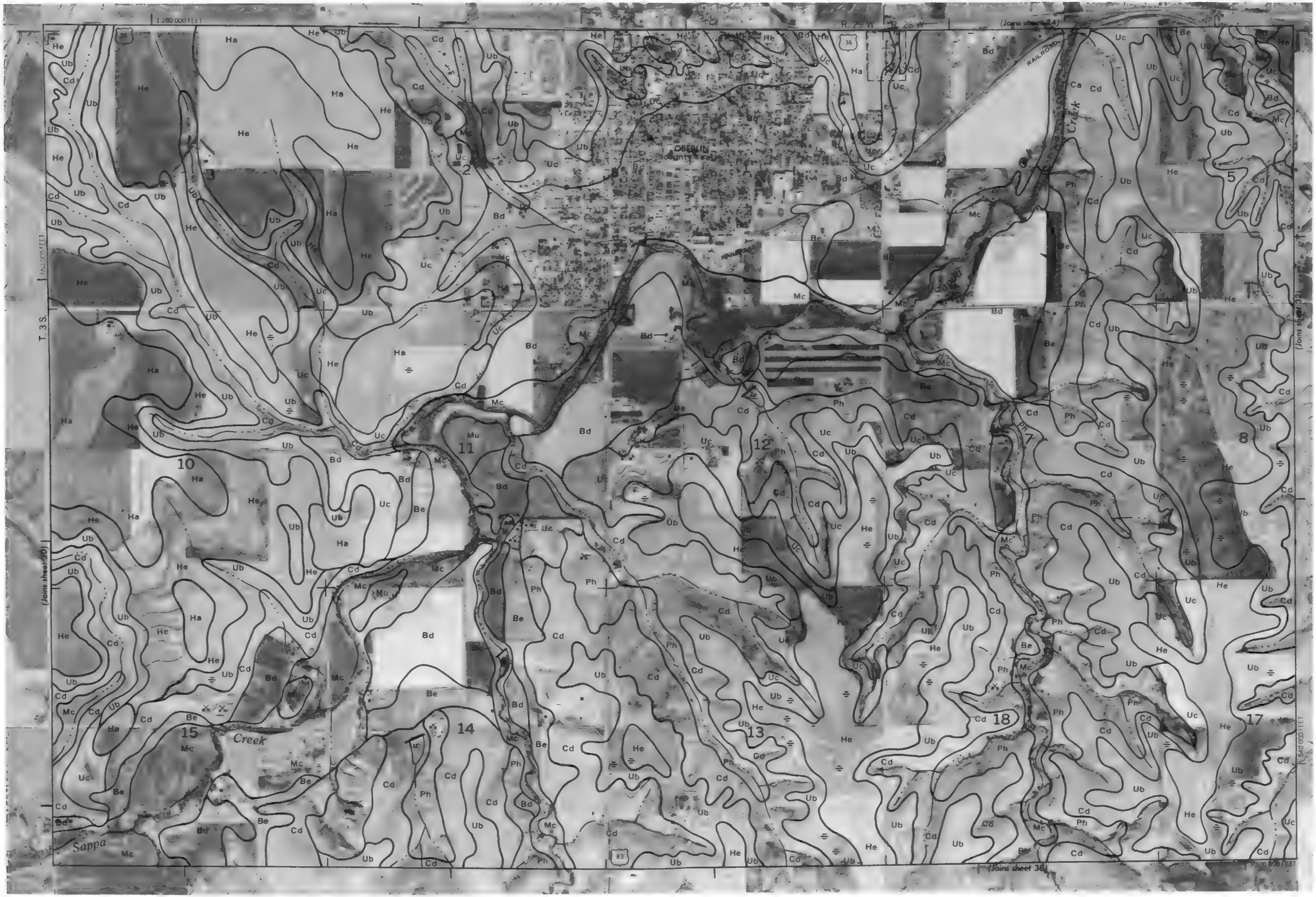
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 30

31



N

1 MILE

1 KILOMETER

Scale 1:20000

DECATUR COUNTY, KANSAS NO. 31

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

32

N

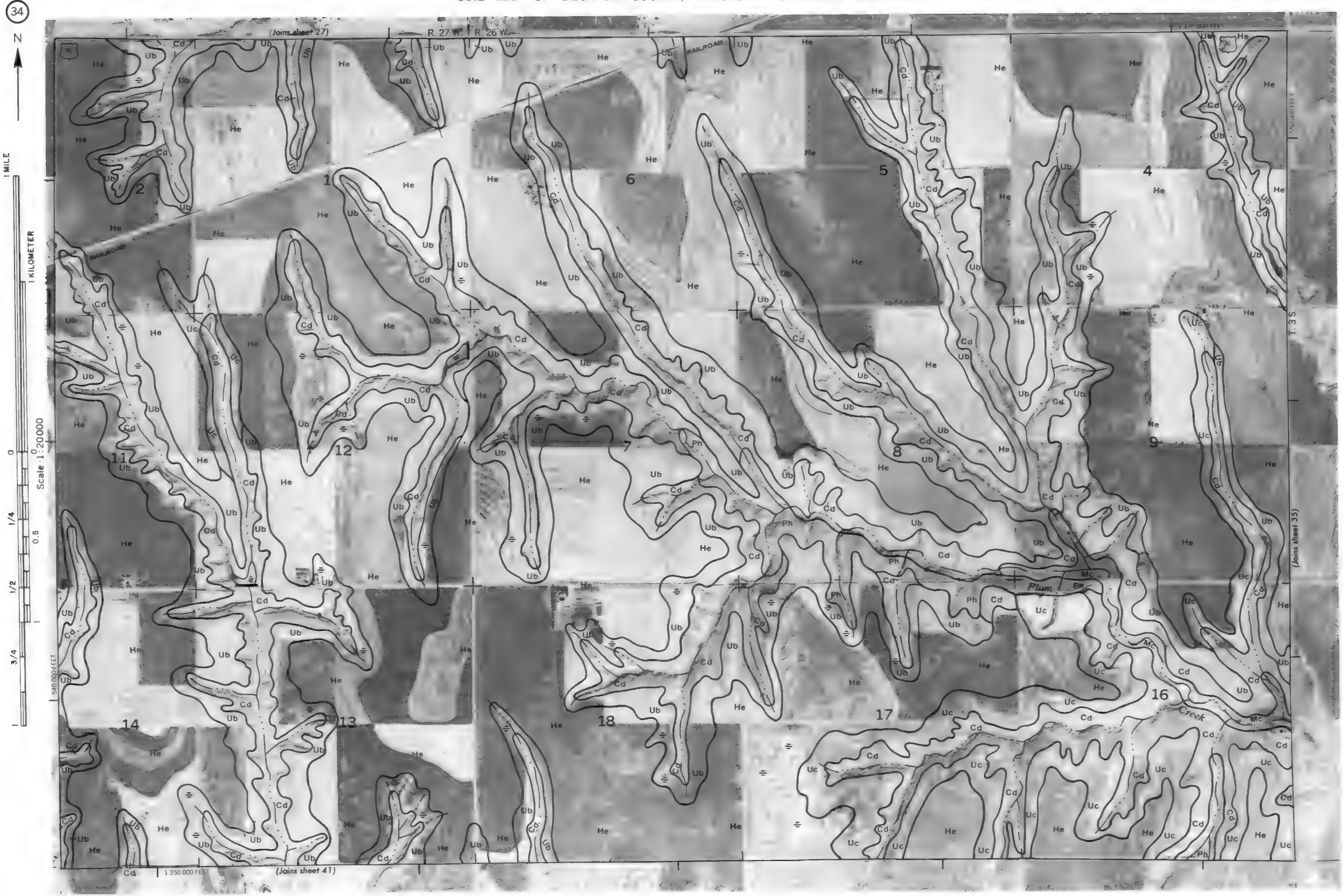
1 MILE
1 KILOMETER
Scale 1:20000
0 1/4 1/2 3/4 1
0 0.5 1

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 33

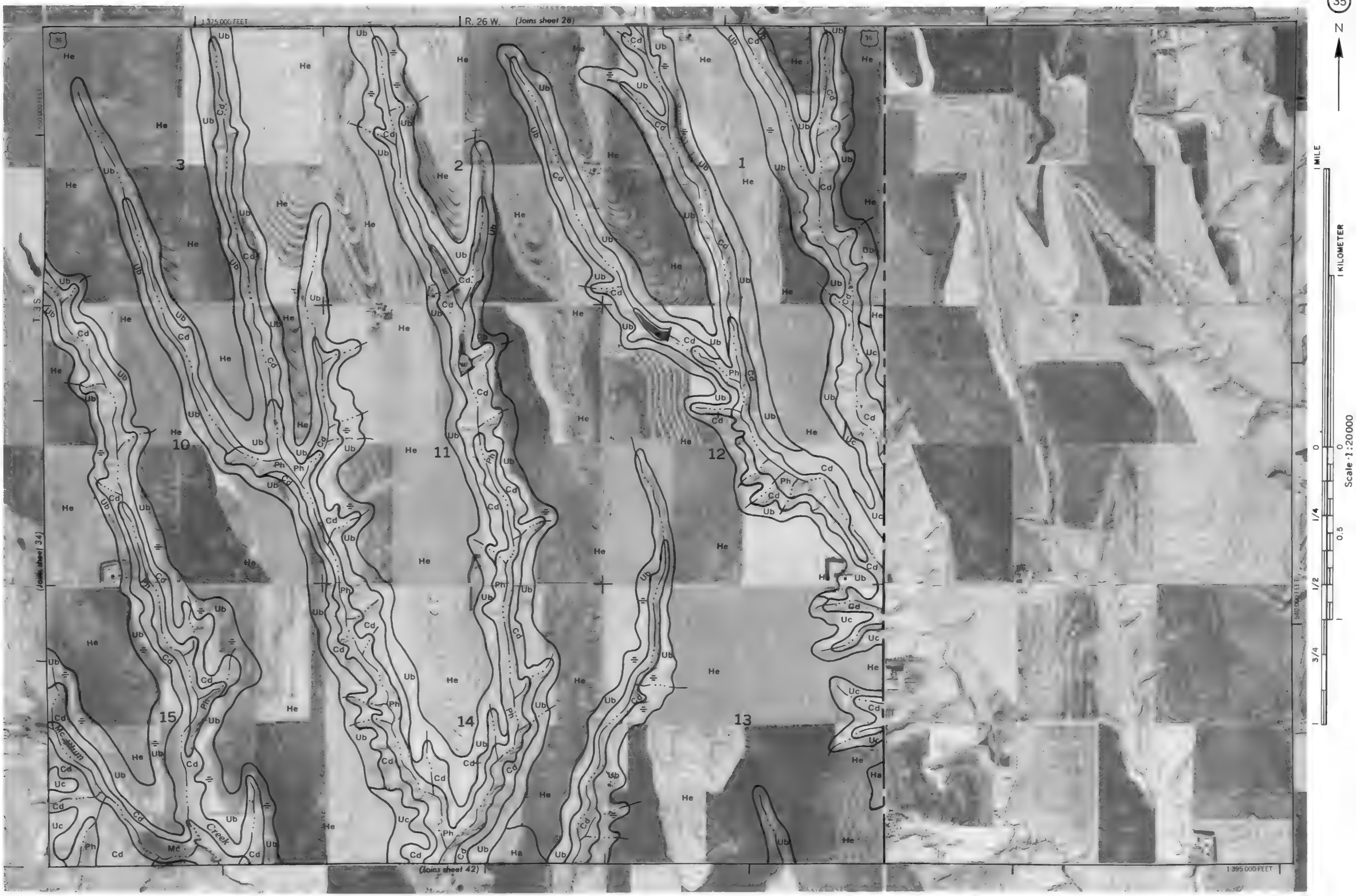
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 34



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners if shown are approximately positioned

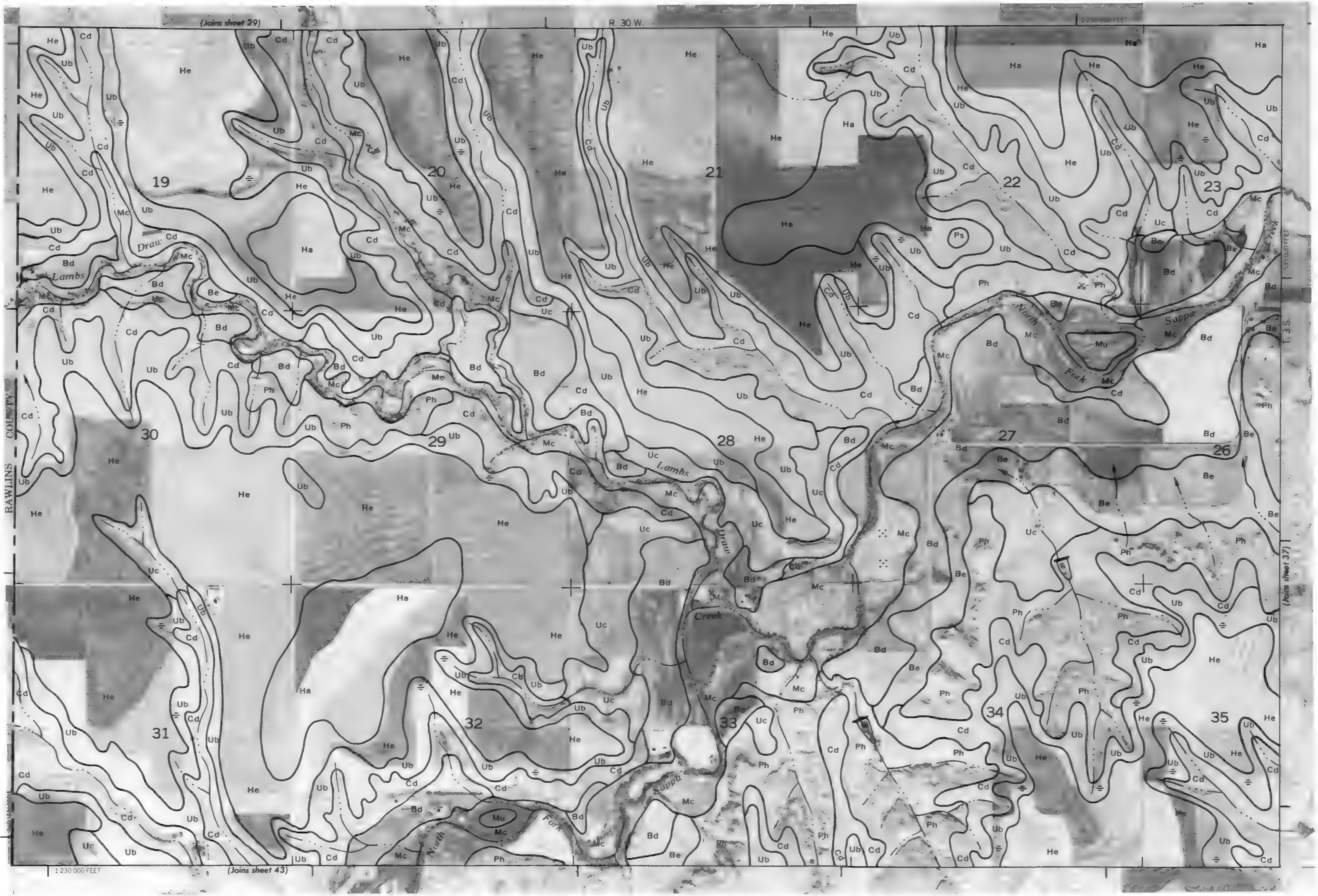
DECATUR COUNTY, KANSAS NO. 34



DECATUR COUNTY, KANSAS NO. 35

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

36



N

1 MILE

1 KILOMETER

Scale 1:20000

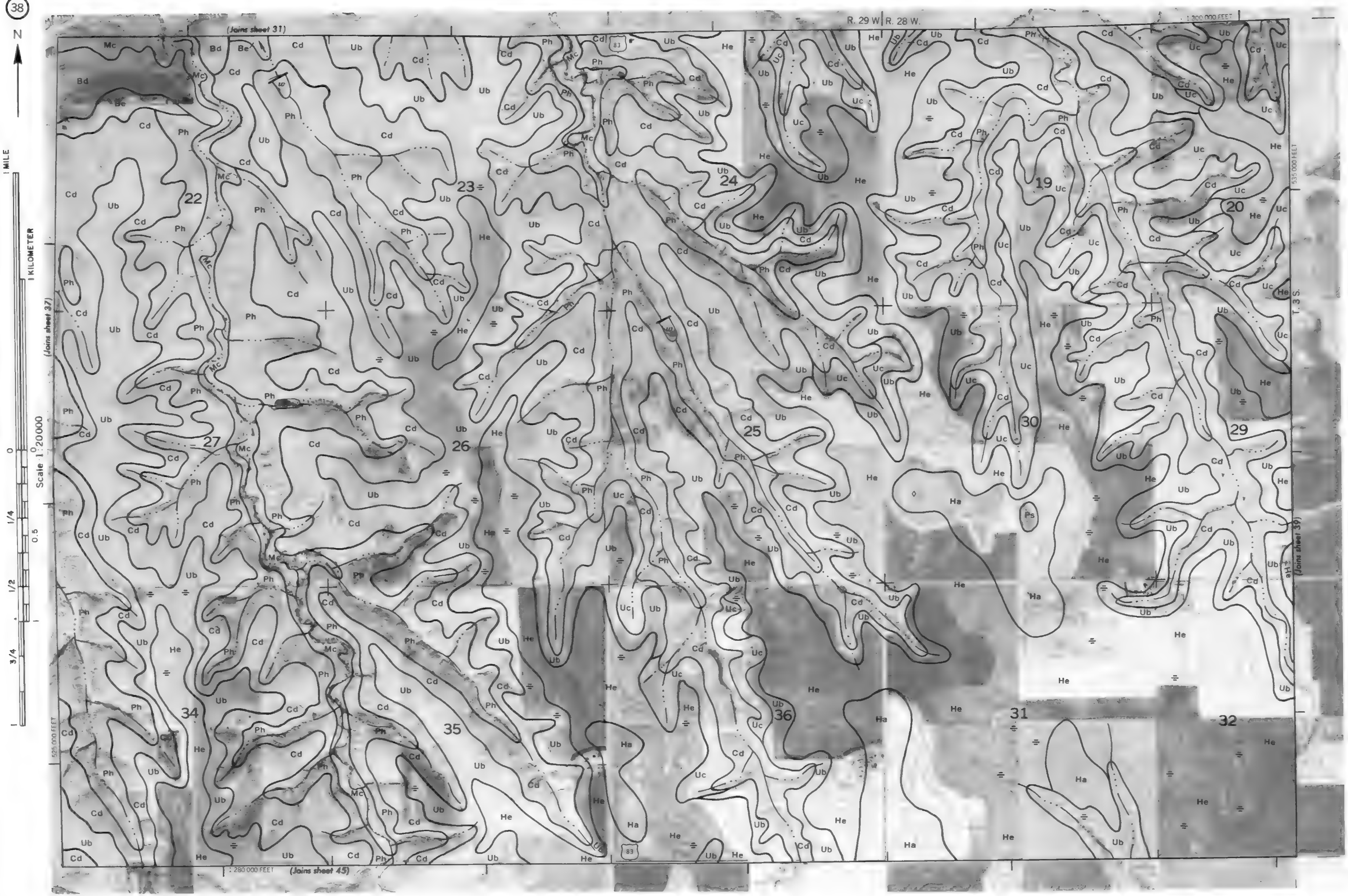
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 36

DECATUR COUNTY, KANSAS NO. 37

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 38



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

DECATUR COUNTY, KANSAS NO. 38

DECATUR COUNTY, KANSAS NO. 39

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

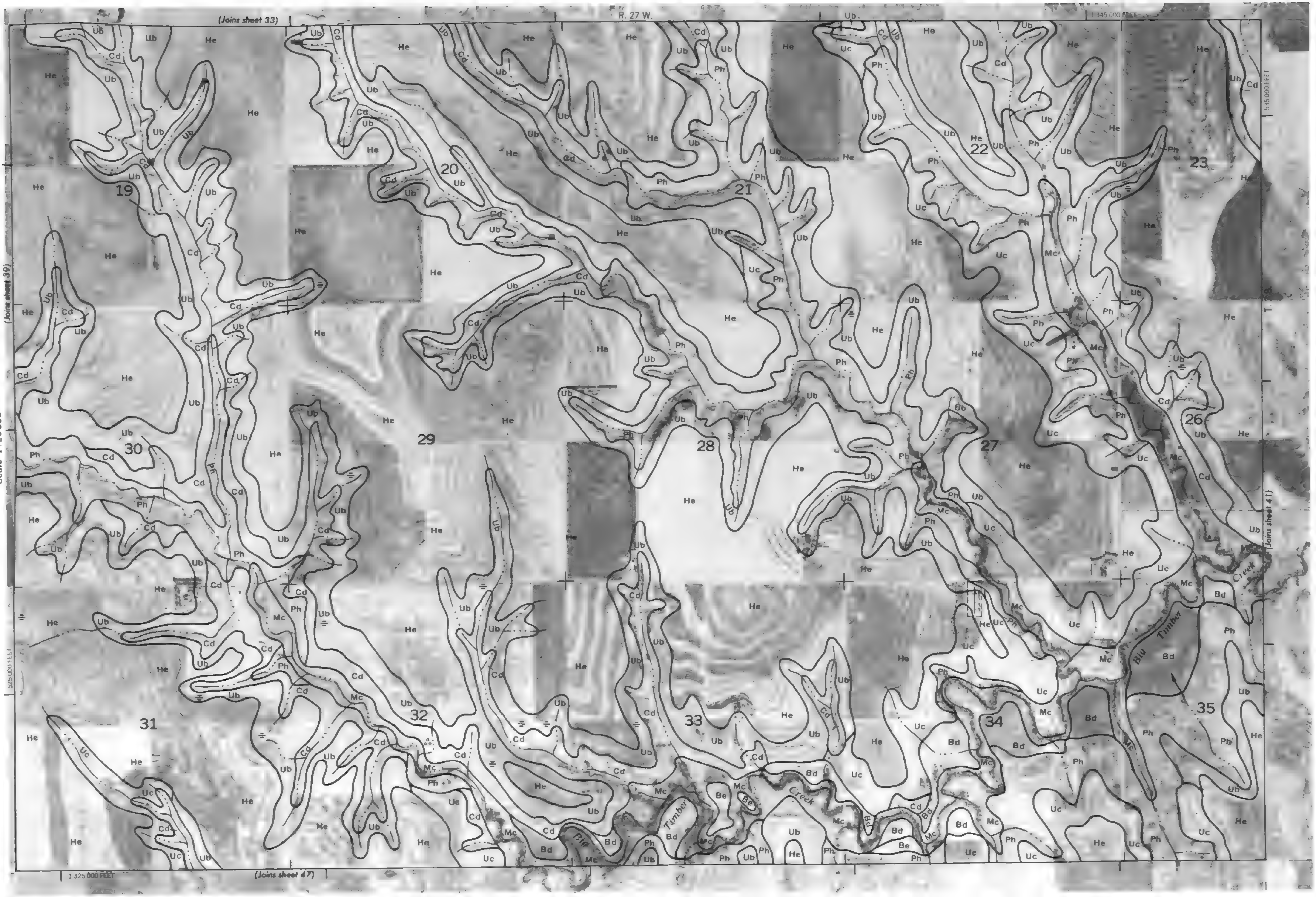
40

N

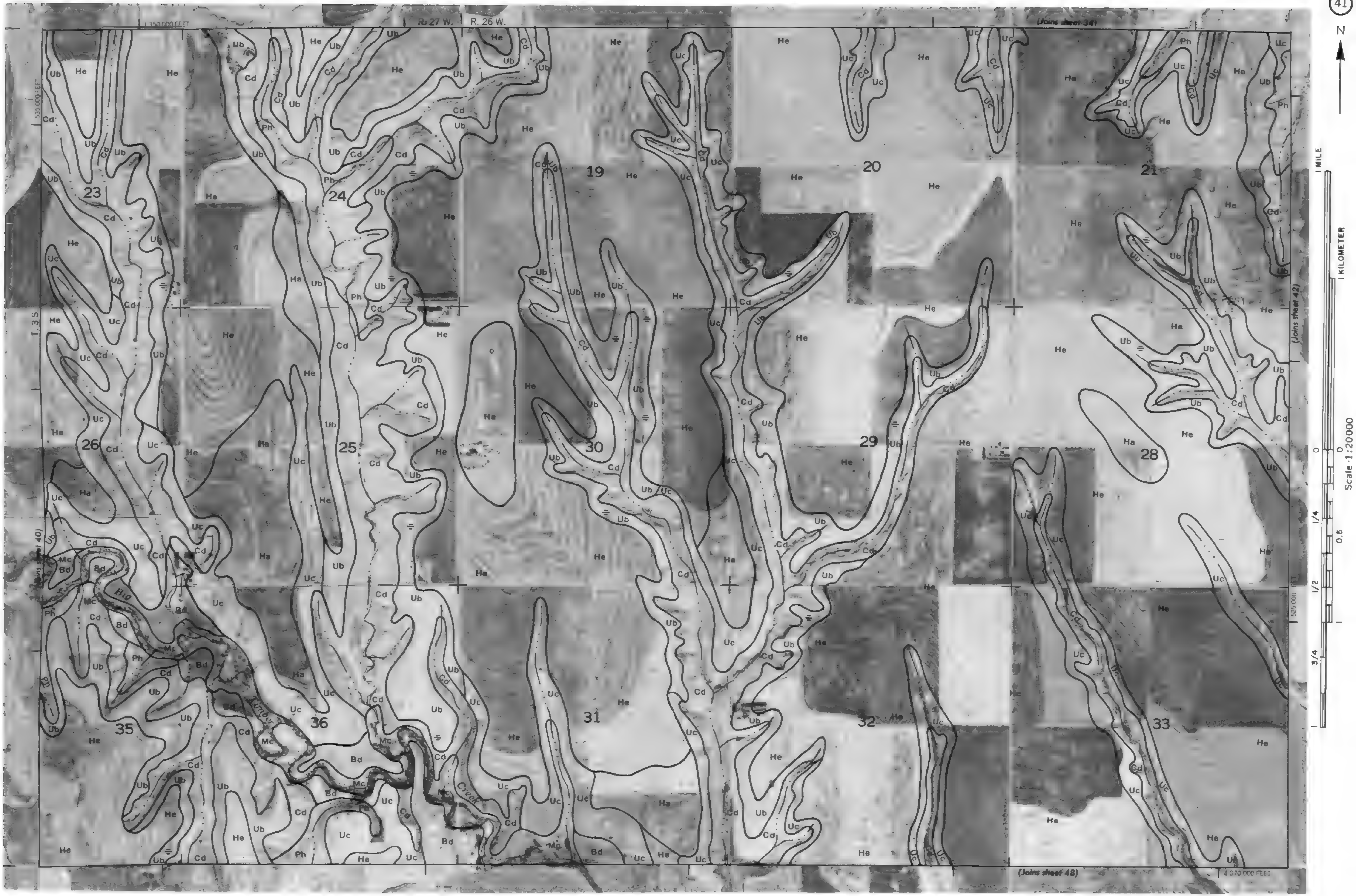
1 MILE

1 KILOMETER

Scale 1:20000



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned



DECATUR COUNTY, KANSAS NO. 41

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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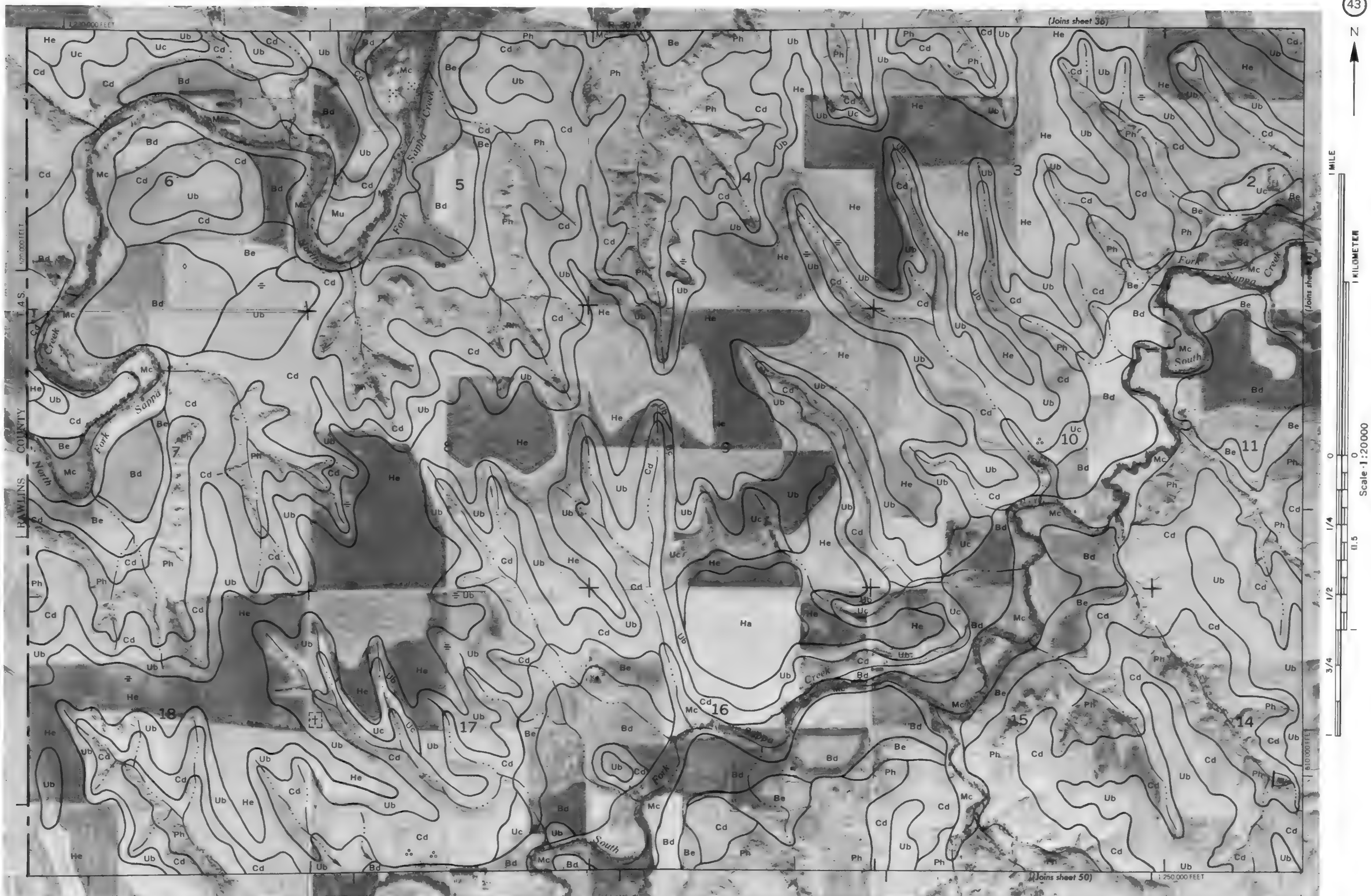
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 42



DECATUR COUNTY, KANSAS NO. 43

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

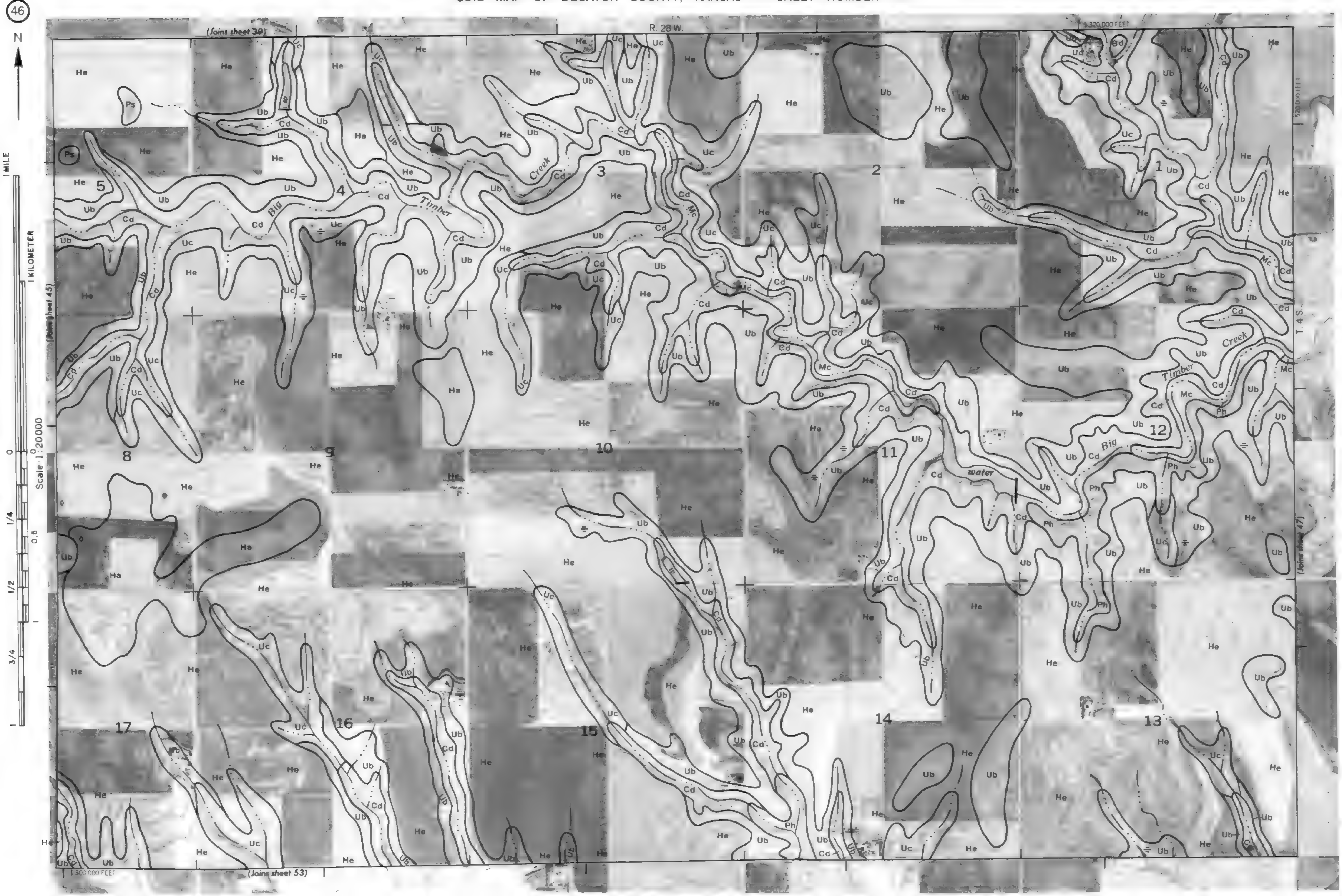
SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 44

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

DECATUR COUNTY, KANSAS NO. 44

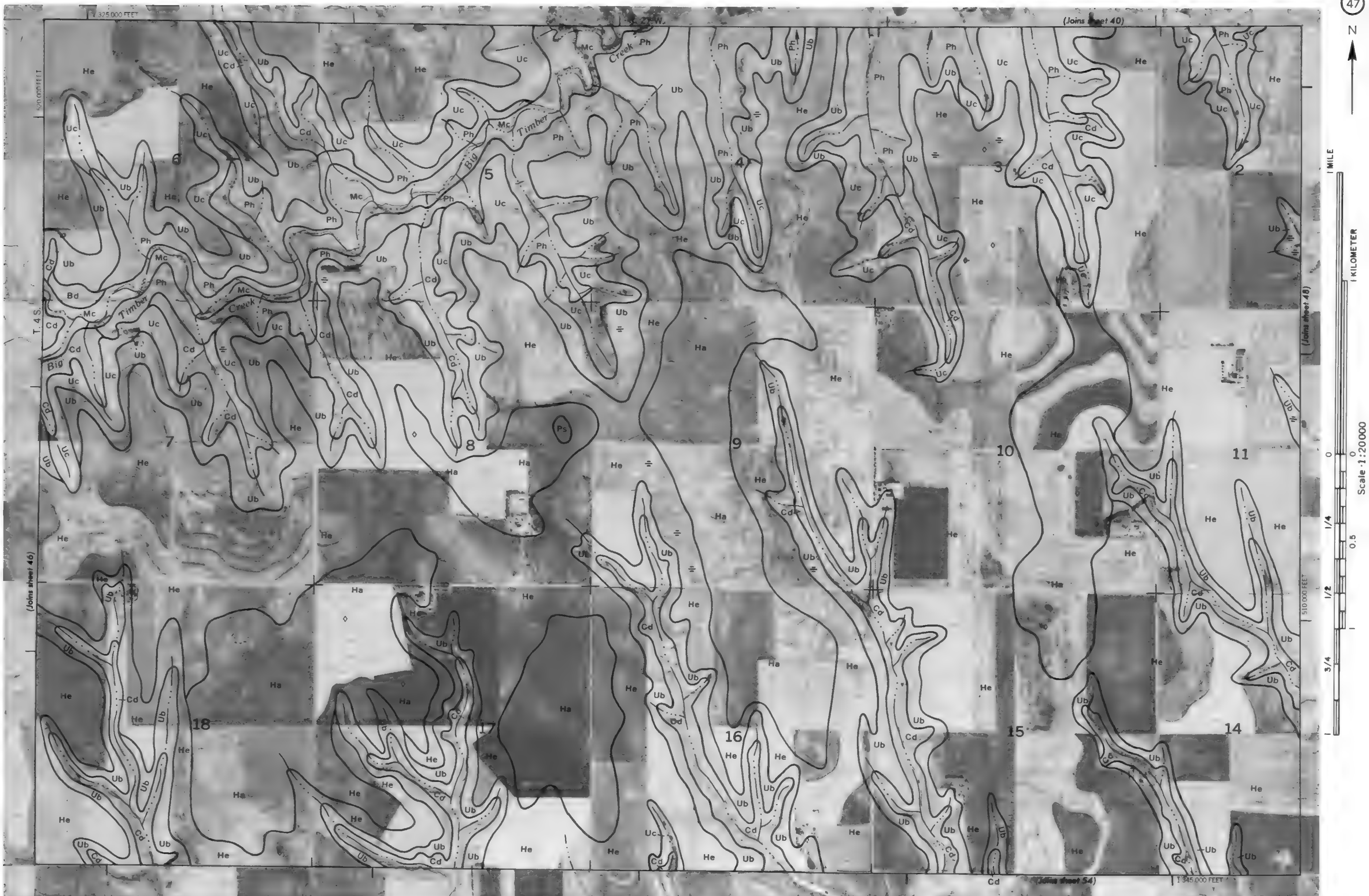
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

46



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

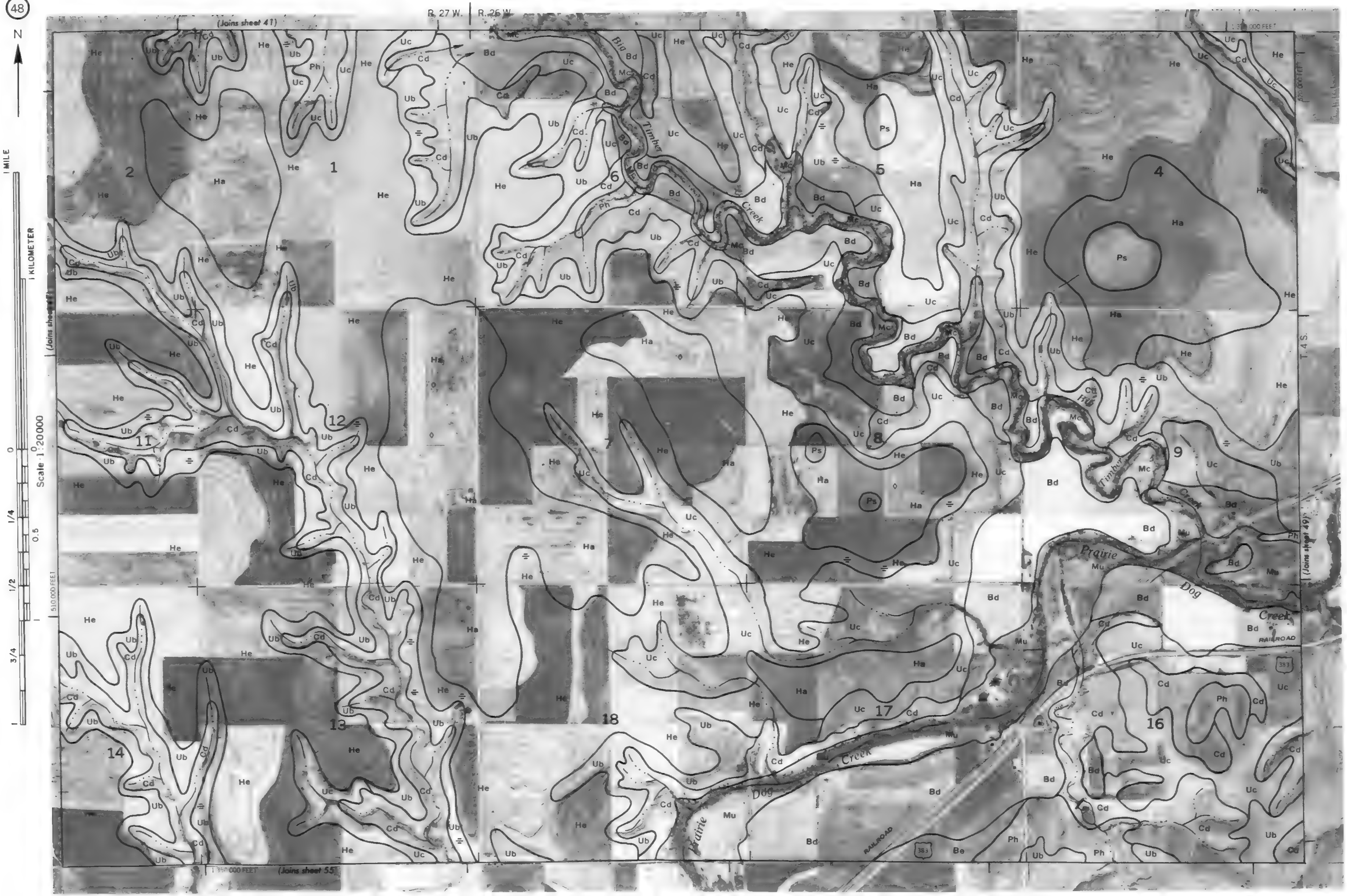
DECATUR COUNTY, KANSAS NO. 46



DECATUR COUNTY, KANSAS NO. 47

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 48

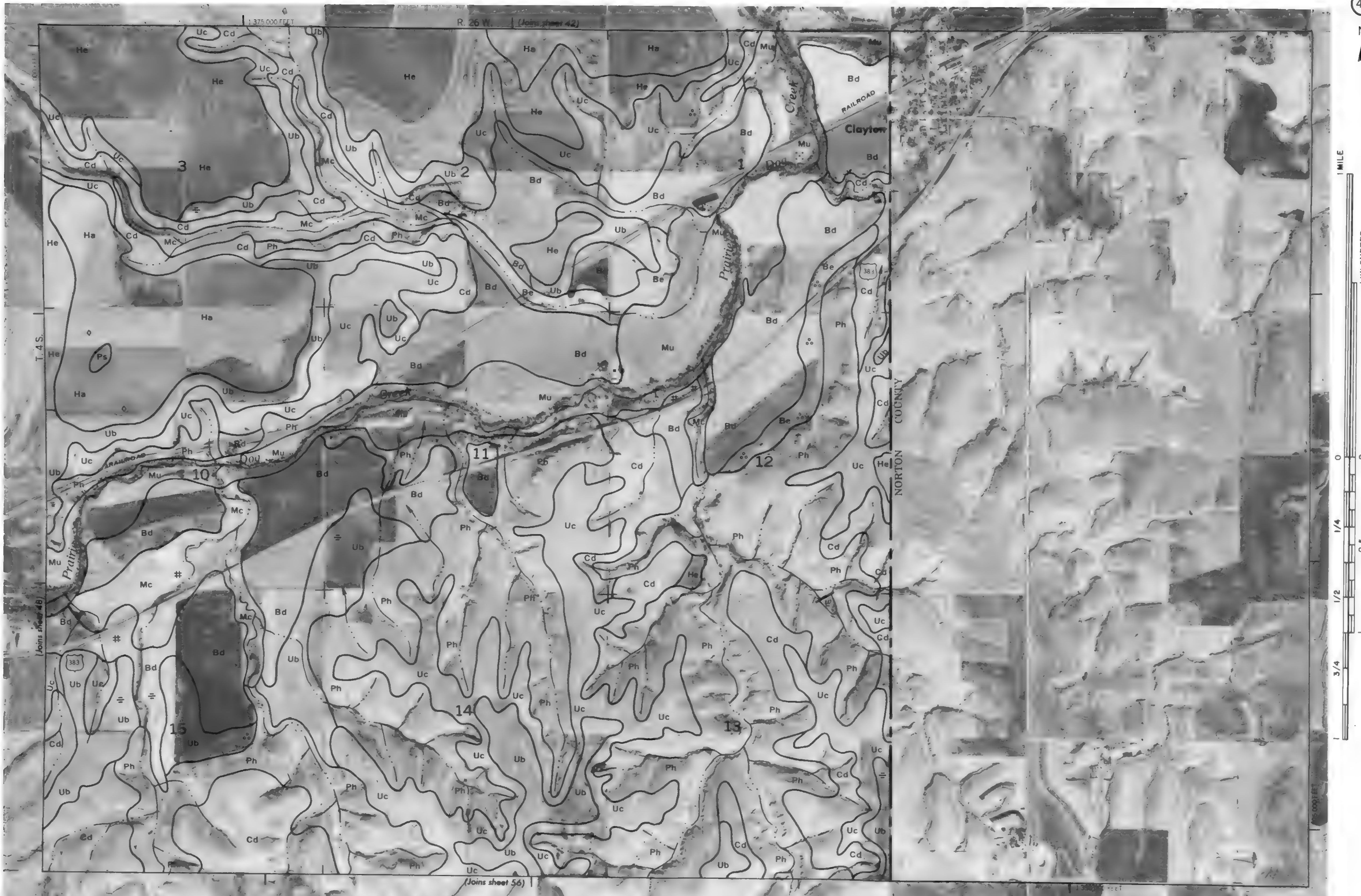


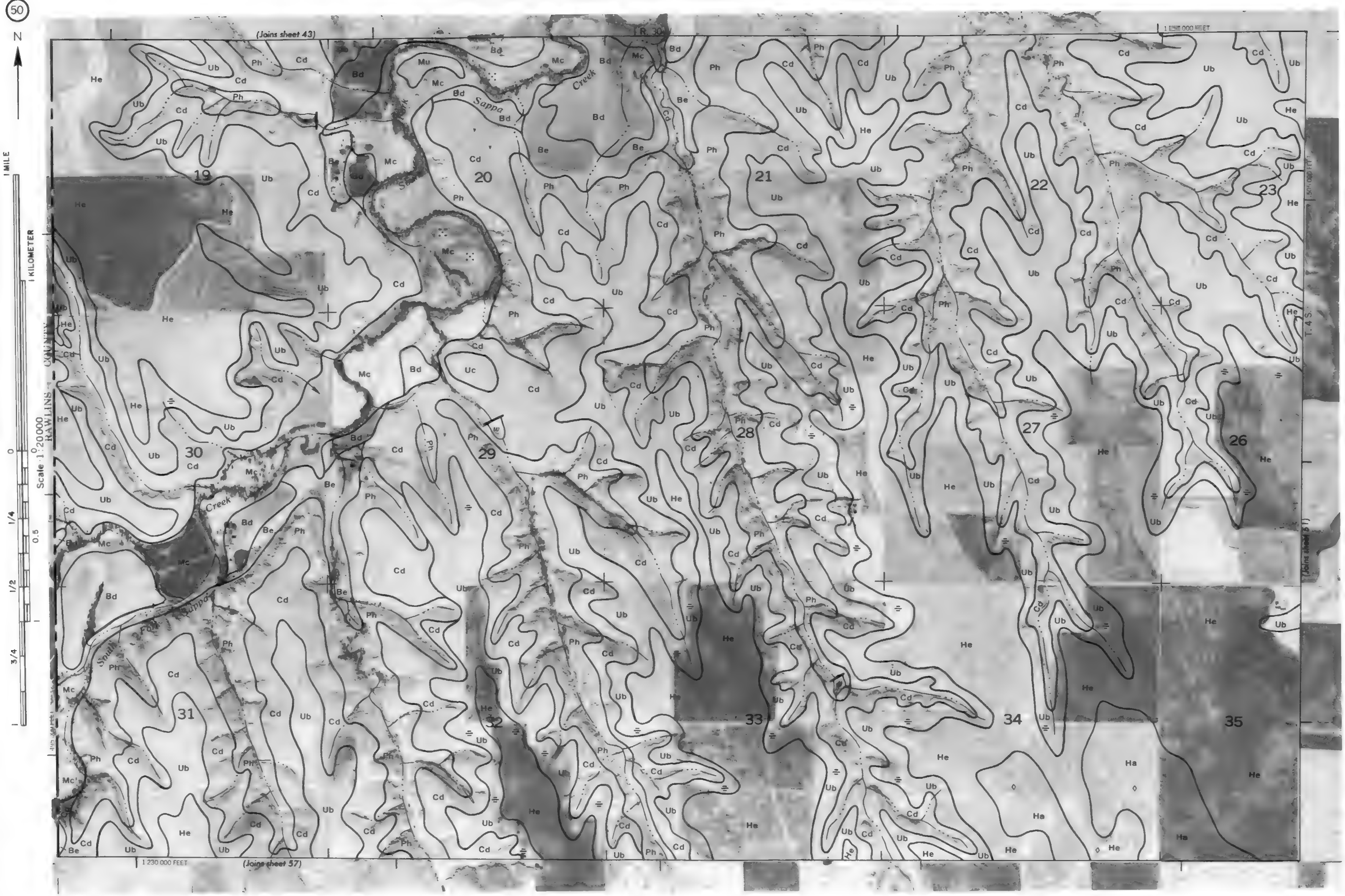
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

DECATUR COUNTY, KANSAS NO. 48

DECATUR COUNTY, KANSAS NO. 49

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned





This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 50

DECATUR COUNTY, KANSAS NO. 51

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners if shown are approximately positioned

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 52

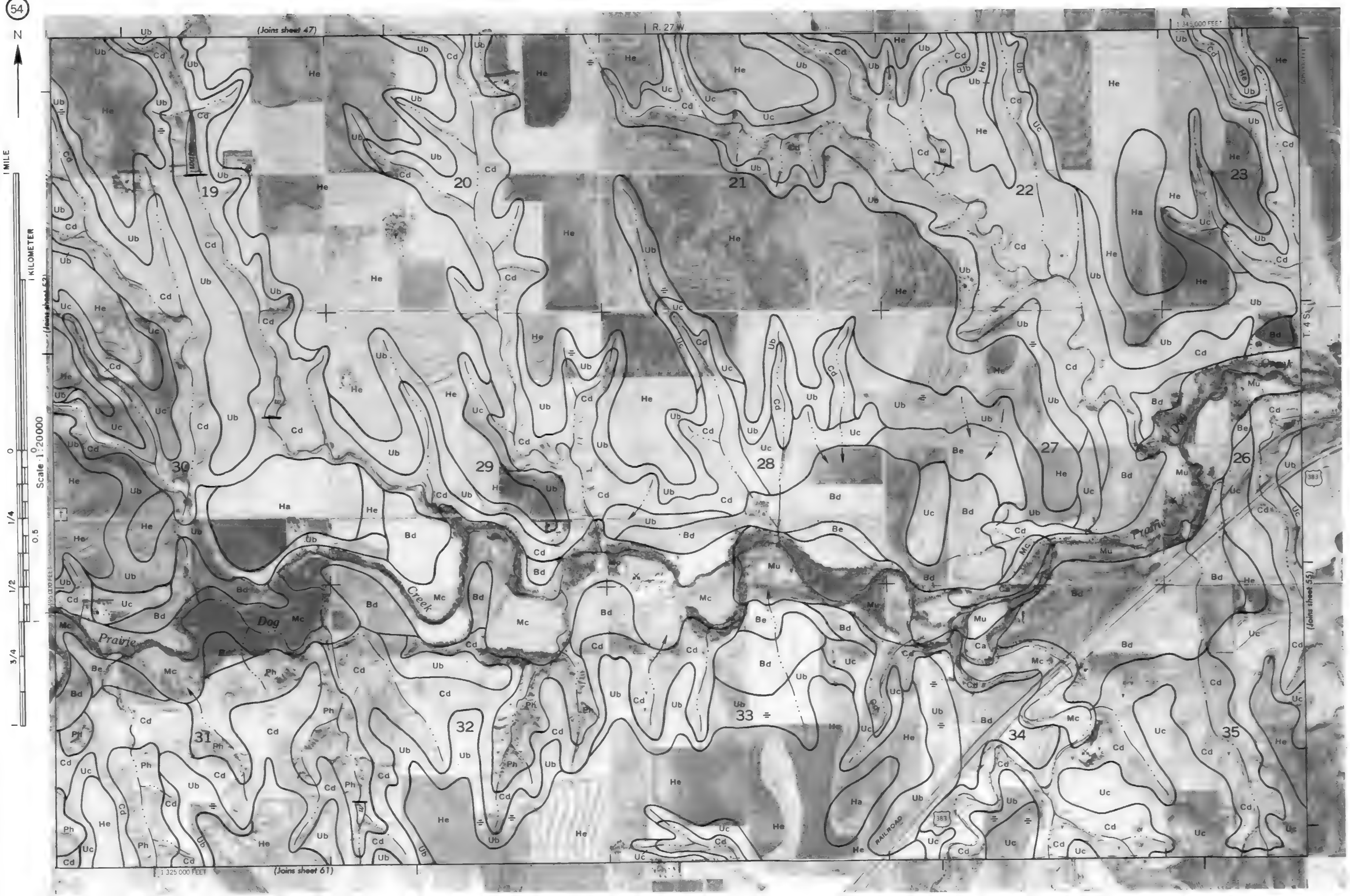
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 52

DECATUR COUNTY, KANSAS NO. 53

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 54



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 54

DECATUR COUNTY, KANSAS NO. 55

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

56

N

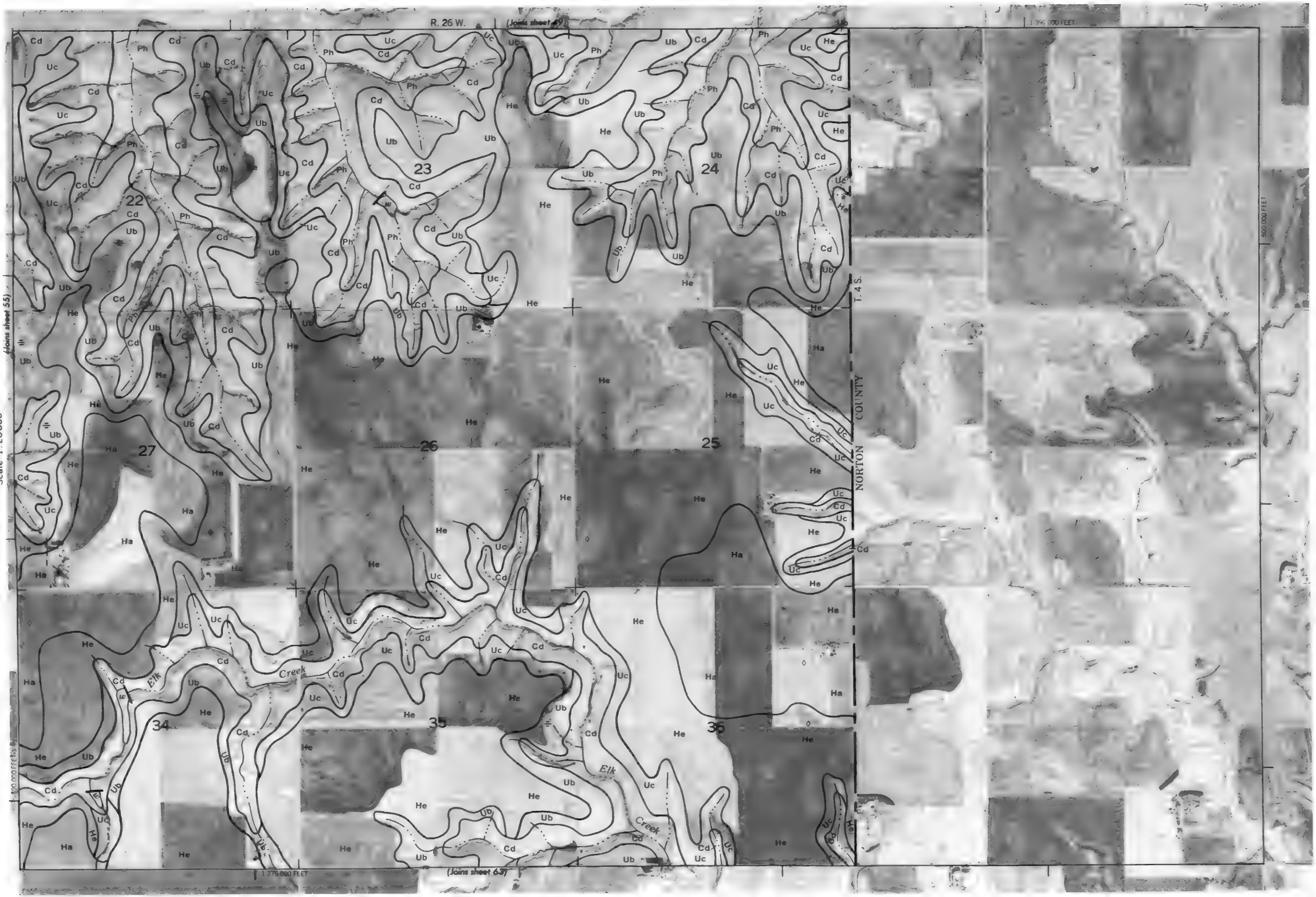
1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1



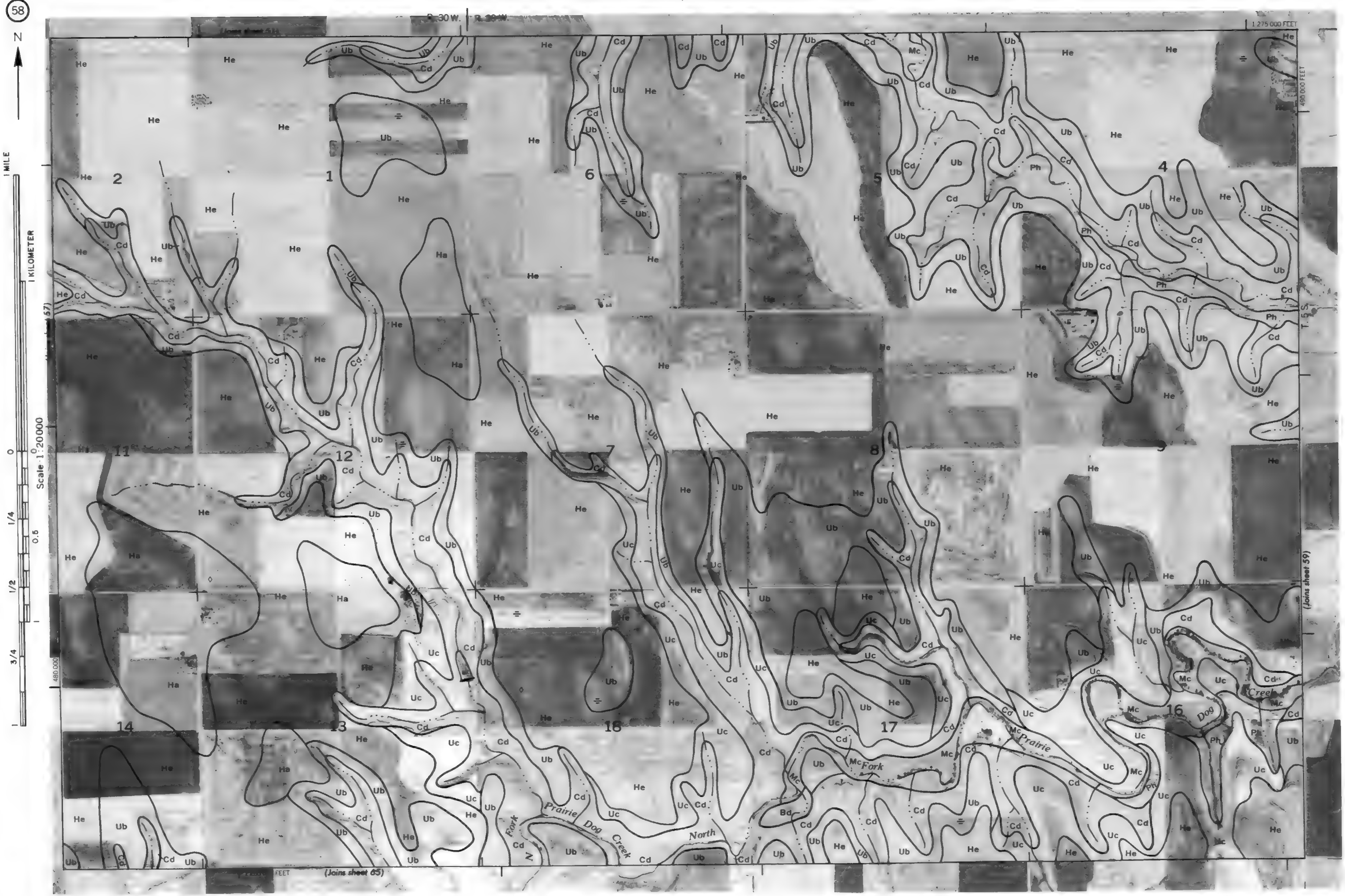
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners if shown are approximately positioned.

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

DECATUR COUNTY, KANSAS NO. 57

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

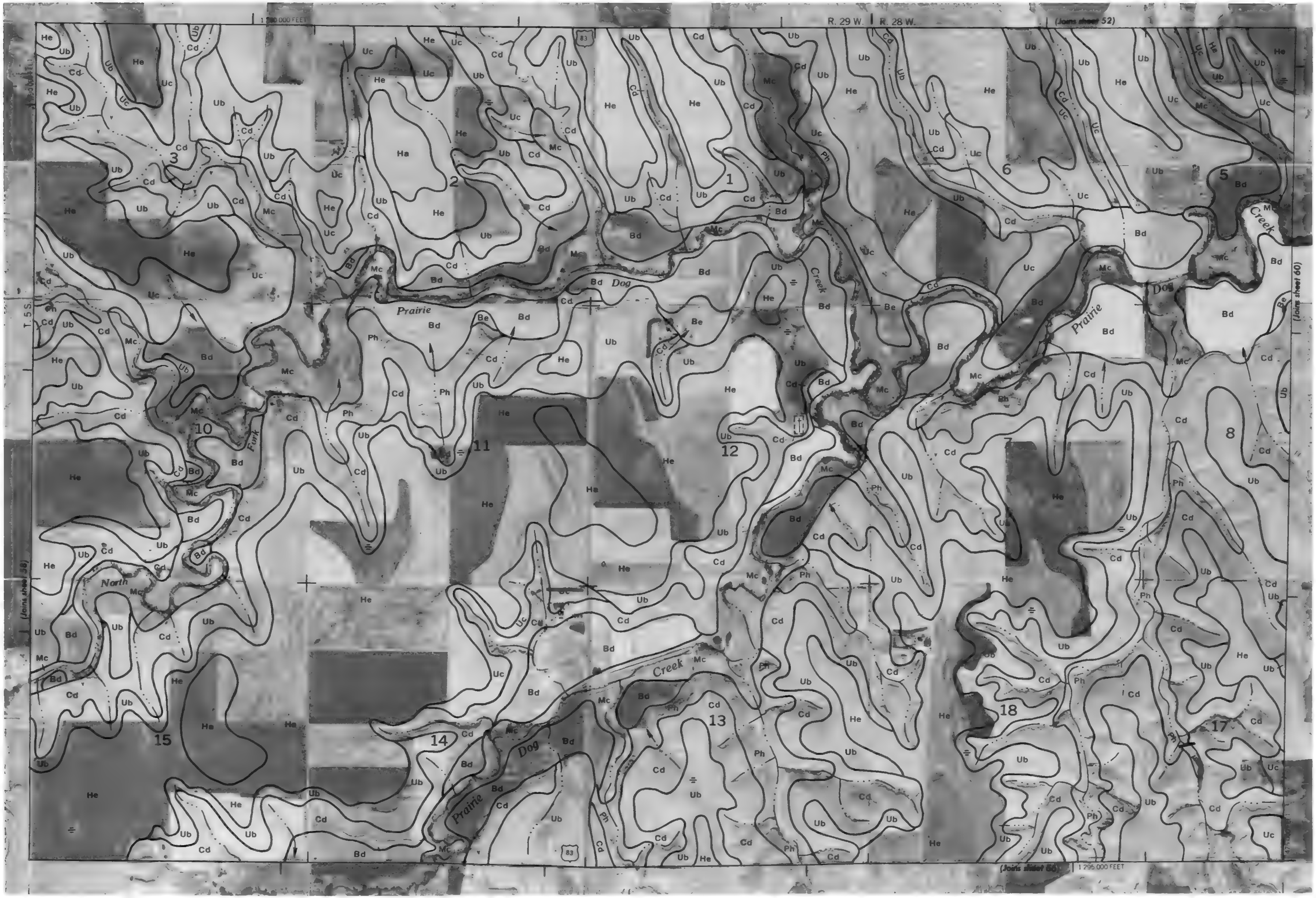
SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 58



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

DECATUR COUNTY, KANSAS NO. 58

59



N

1 MILE

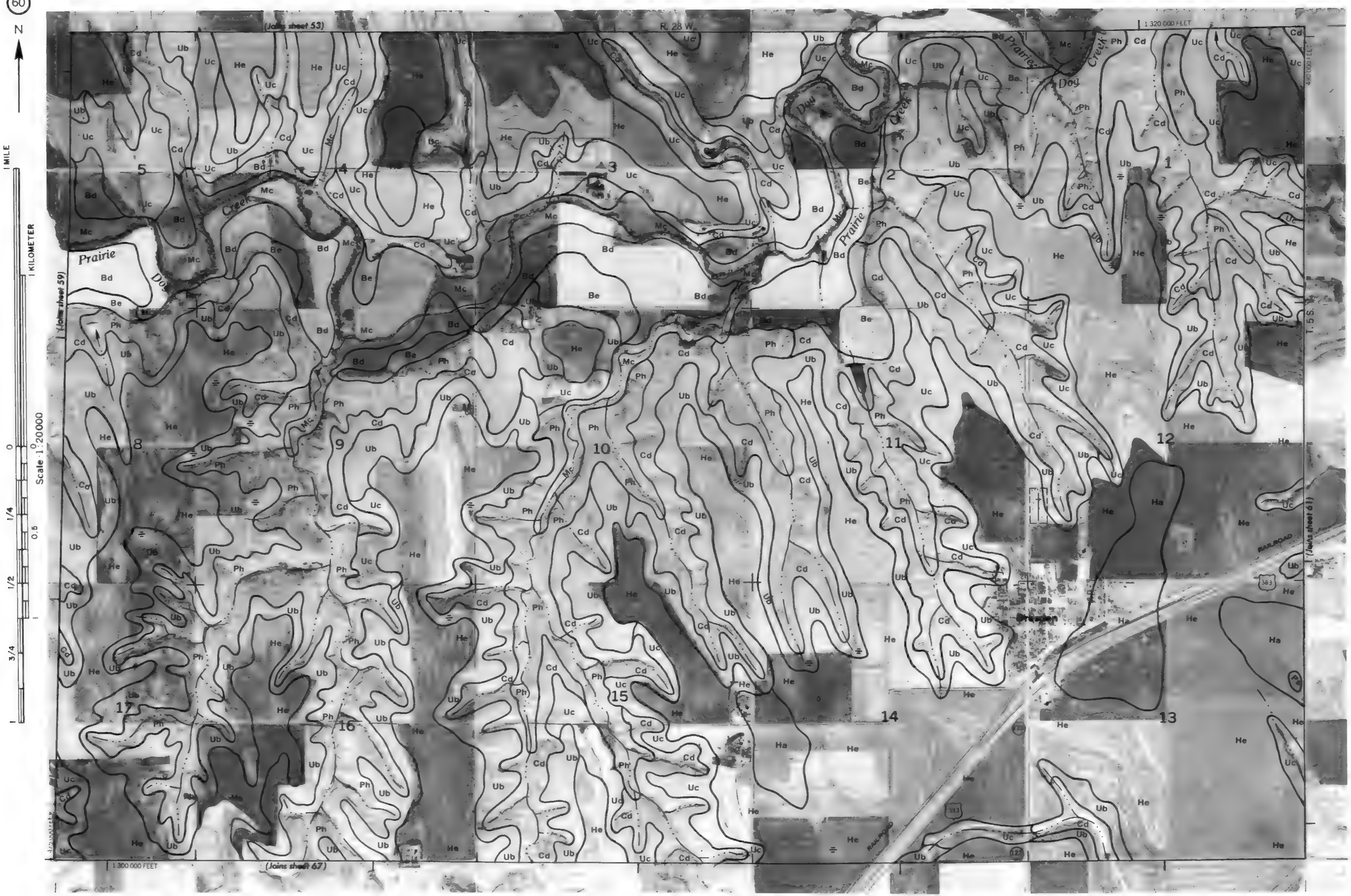
1 KILOMETER

Scale 1:20000

DECATUR COUNTY, KANSAS NO. 59

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 60



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

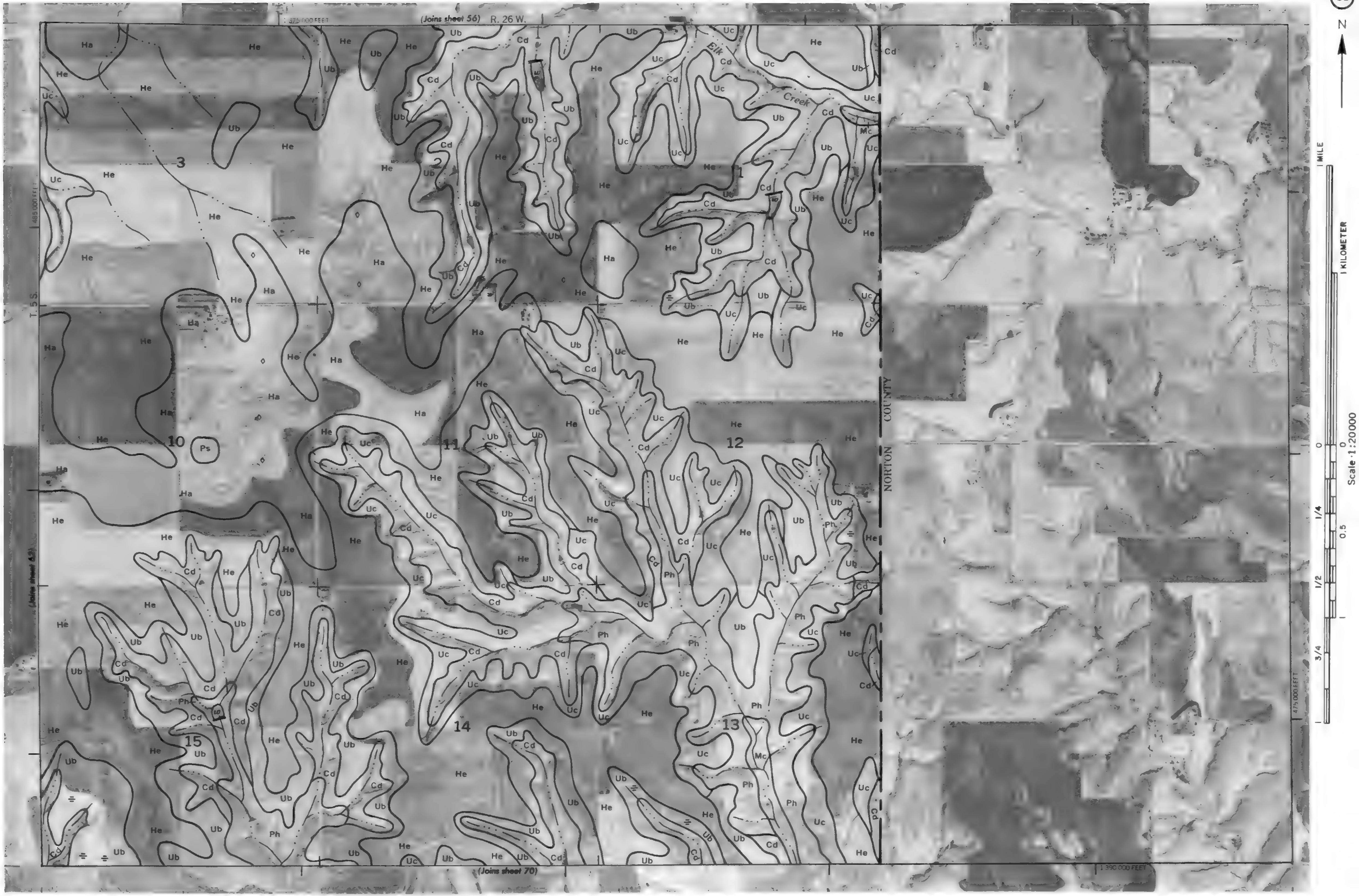
DECATUR COUNTY, KANSAS NO. 61

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners if shown are approximately positioned.

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners if shown are approximately positioned.

DECATUR COUNTY, KANSAS NO. 63

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 64

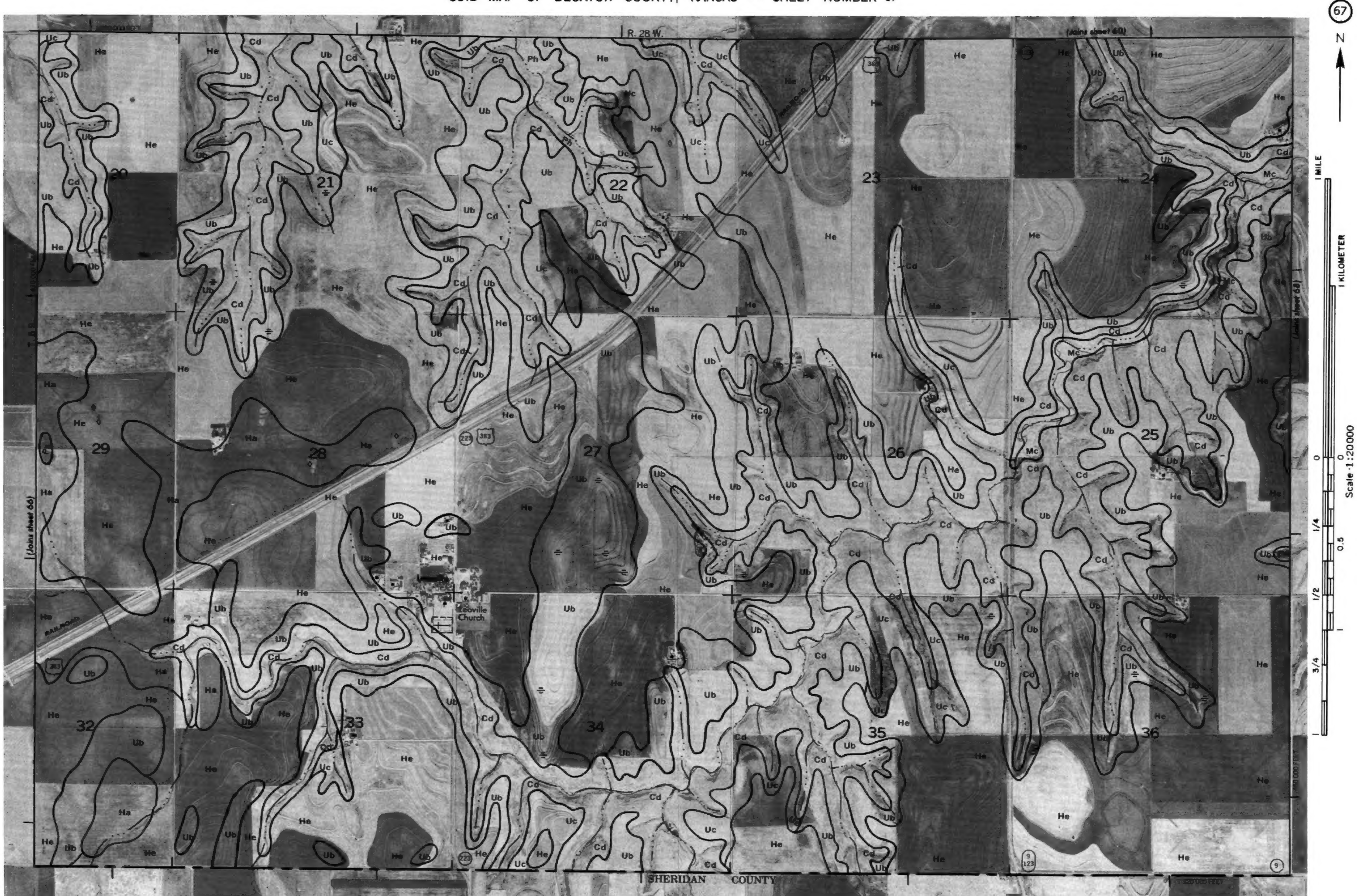
DECATUR COUNTY, KANSAS NO. 65

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 66

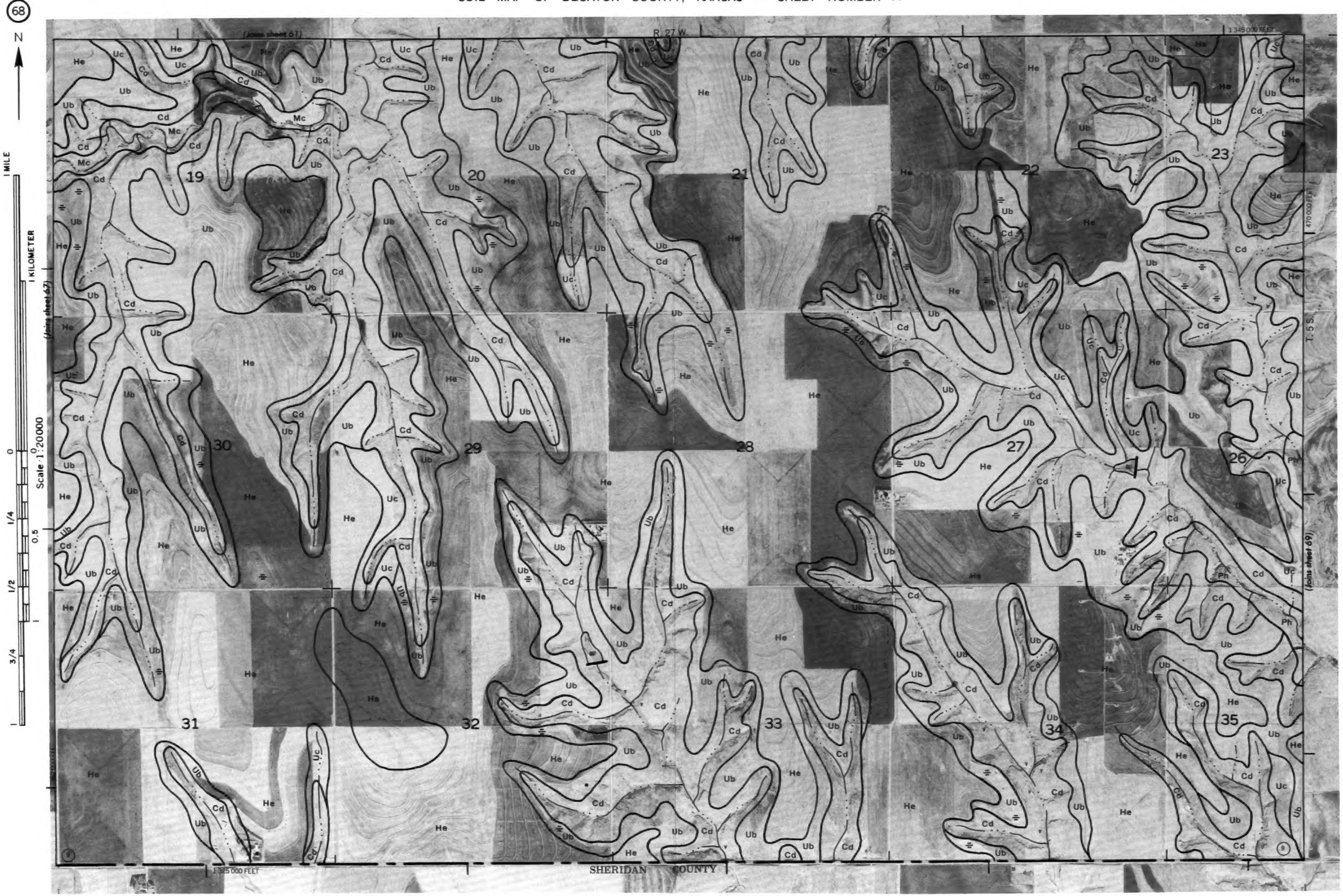
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 66



DECATUR COUNTY, KANSAS NO. 67

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(69)

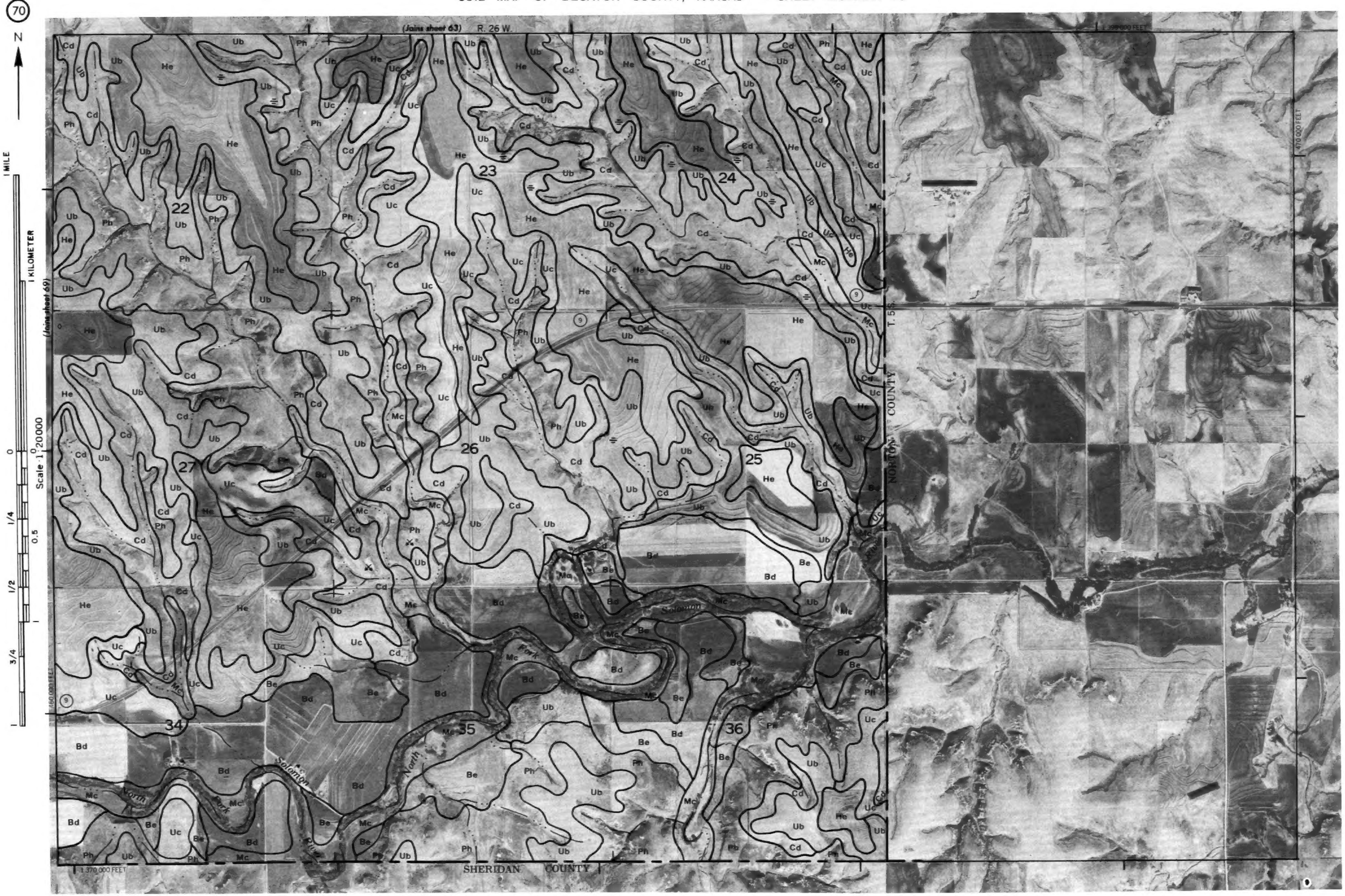
N

1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000

DECATUR COUNTY, KANSAS NO. 69

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF DECATUR COUNTY, KANSAS — SHEET NUMBER 70



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DECATUR COUNTY, KANSAS NO. 70